IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Attorney Docket No. MSFT114130

TRANSMITTAL LETTER

Seattle, Washington 98101

July 26, 1999

TO THE ASSISTANT COMMISSIONER FOR PATENTS:

Transmitted herewith for filing under 37 C.F.R. § 1.53(b) by Express Mail is the

______ a. complete

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patent application of:

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Title: SYSTEM, METHOD AND APPARATUS FOR SUPPORTING A KERNEL MODE DRIVER

Executed On: July 26, 1999

__X__ 1. An application consisting of 46 pages of specification and claims and 6 sheets of drawings is attached.

__X__ 2. A Declaration and Power of Attorney is not attached. Please file this application in the name of the inventors listed above (full names of all).

__X__ 3. A filing date in accordance with 37 C.F.R. § 1.10 is requested. The Express Mail Certificate appears below.

__X__ 4. No fee is enclosed.

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SYSTEM, METHOD AND APPARATUS FOR SUPPORTING A KERNEL MODE DRIVER

Field of the Invention

The present invention generally relates to management instrumentation systems, and more specifically relates to computer systems having instrumented hardware devices.

Background of the Invention

Background of WBEM

Corporations and other enterprises have a need to monitor the performance and status of elements of their computer networks to prevent data loss and to maximize resource efficiency. The computer industry is addressing that need by putting together the concept of Web-Based Enterprise Management ("WBEM"). WBEM is an industry initiative to develop a standardized, nonproprietary means for accessing and sharing management information in an enterprise network. The WBEM initiative is intended to solve the problem of collecting end-to-end management and diagnostic data in enterprise networks that may include hardware from multiple vendors, numerous protocols and operating systems, and a legion of distributed applications

The founding companies of the WBEM initiative developed a prototype set of environment-independent specifications for how to describe and access any type of management instrumentation, including existing standards such as Simple Network Management Protocol and Desktop Management Interface. A core component of the specification is a standard data description mechanism known as the Common Information Model ("CIM"). The CIM specification describes the modeling language, naming, and

mapping techniques used to collect and transfer information from data providers and other management models. The Windows Management Instrumentation ("WMI") system is a Windows-based implementation of the CIM specification and is fully compliant with the WBEM initiative.

One component of WMI is the Extensions to the Windows Driver Model ("WDM") provider (the "WMI provider") for kernel component instrumentation. The WMI provider interfaces with a kernel mode driver, coded in accordance with the Extensions to WDM specification, to pass WMI data between user mode and kernel mode. WMI uses the WMI provider to publish information, configure device settings, and supply event notification from device drivers.

Identification of the Problem

Although the WMI provider is a key component in making the WMI system work, it is not without disadvantages. First, manufacturers must add substantial additional code to their device drivers to support the WMI system. At present, each manufacturer must independently develop software methods and functions to incorporate in their device drivers to support the WMI Extensions to WDM specification. This creates a burden shared by every developer of device drivers intended to be used with the WMI system. It takes additional time for each developer to produce both the code specific to the developer's device, and the code specific to the WMI system. Second, because similar code is used in each device driver to support WMI, many instances of functionally-identical code are loaded in memory by the several drivers. The result is an inefficient operating state containing more system overhead than needed to support WMI. Overall system performance may suffer. Third, the likelihood of coding errors, or "bugs," is increased when many disparate vendors develop code to perform substantially the same function.

Accordingly, a need exists for a mechanism that allows disparate device drivers intended to interface with the WMI system to share code designed to operate with the WMI system.

Summary of the Invention

The present invention addresses the above described needs and disadvantages by providing a set of common software routines that may be accessed by device drivers in support of the WMI system. The set of common routines includes typical routines that would ordinarily be executed by device drivers designed in accordance with WMI. The common routines may reside in a library, dynamically accessible by the device drivers. When a device driver receives a message from the WMI system, the device driver may pass the message to the library to be handled in a common manner. In this manner, the developers of device

drivers in accordance with the WMI system need only develop so much code as is necessary to support any unique features or data storage of its associated hardware. The result is shortened development time and fewer programming errors. In addition, the overall system performance may be improved because fewer instances of similar code are loaded in memory to support the WMI system.

While the preferred implementation of the present invention provides a dynamically linked library, some driver standards, such as the Small Computer Systems Interface ("SCSI") miniport standard, do not allow for accessing code in a dynamically linked library. For those drivers, the library may be included as a static part of the driver at link-time. Although this solution may still result in multiple instances of the same code in memory, the development time is still shortened, and the typicality of the code results in a more stable WMI and Windows system. Also, the use of the library allows the underlying WMI infrastructure to be modified without affecting the developer's driver so long as the interface to the library is maintained.

Brief Description of the Drawings

The foregoing aspects and many of the attendant advantages of this invention will become more readily appreciated as the same becomes better understood by reference to the following detailed description, when taken in conjunction with the accompanying drawings, wherein:

FIGURE 1 is a functional block diagram of a computer suitable for providing an exemplary operating environment for the present invention;

FIGURE 2 is a functional block diagram of software components embodying the present invention resident on the computer system of FIGURE 1;

FIGURE 3 is a functional block diagram illustrating the concept of moving typical code from multiple drivers to a common library in accordance with the present invention;

FIGURE 4 is a functional block diagram illustrating the concept of a driver stack serviced by the common library of FIGURE 3;

FIGURE 5 is an event trace illustrating the flow of processing that occurs in a common library system in accordance with the present invention;

FIGURE 6 is a logical flow diagram illustrating steps performed by a process for utilizing a common driver library in accordance with the present invention; and

FIGURE 7 is a logical flow diagram illustrating steps performed by a process for generating an event message through the use of a common driver library, in accordance with the present invention.

Detailed Description of the Preferred Embodiment

The present invention is directed to a system and method for supporting a system of kernel mode device drivers that share common code by moving that common code to a software library. The present invention may be embodied in a management instrumentation system, such as the WMI system promoted by the Microsoft Corporation of Redmond, Washington.

Exemplary Operating Environment

FIGURE 1 and the following discussion are intended to provide a brief, general description of a suitable computing environment in which the invention may be implemented. While the invention will be described in the general context of an application program that runs on an operating system in conjunction with a personal computer, those skilled in the art will recognize that the invention also may be implemented in combination with other program modules. Generally, program modules include routines, programs, components, data structures, etc. that perform particular tasks or implement particular abstract data types. Moreover, those skilled in the art will appreciate that the invention may be practiced with other computer system configurations, including hand-held devices, multiprocessor systems, microprocessor-based or programmable consumer electronics, minicomputers, mainframe computers, and the like. The invention may also be practiced in distributed computing environments where tasks are performed by remote processing devices that are linked through a communications network. In a distributed computing environment, program modules may be located in both local and remote memory storage devices.

Referring to FIGURE 1, an exemplary system for implementing the invention includes a conventional personal computer 20, including a processing unit 21, a system memory 22, and a system bus 23 that couples the system memory to the processing unit 21. The system memory 22 includes read only memory (ROM) 24 and random access memory (RAM) 25. A basic input/output system 26 (BIOS), containing the basic routines that help to transfer information between elements within the personal computer 20, such as during start-up, is stored in ROM 24. The BIOS 26 may additionally store AML code for use in conjunction with an associated ACPI device. The personal computer 20 further includes a hard disk drive 27, e.g. to read from or write to a hard disk 39, a magnetic disk drive 28, e.g., to read from or write to a removable disk 29, and an optical disk drive 30, e.g., for reading a CD-ROM disk 31 or to read from or write to other optical media. The hard disk drive 27, magnetic disk drive 28, and optical disk drive 30 are connected to the system bus 23 by a hard disk drive interface 32, a magnetic disk drive interface 33, and an optical drive interface 34, respectively. The drives and their associated computer-readable media provide

nonvolatile storage for the personal computer 20. Although the description of computer-readable media above refers to a hard disk, a removable magnetic disk and a CD-ROM disk, it should be appreciated by those skilled in the art that other types of media which are readable by a computer, such as magnetic cassettes, flash memory cards, digital video disks, Bernoulli cartridges, and the like, may also be used in the exemplary operating environment.

A number of program modules may be stored in the drives and RAM 25, including an operating system 35, one or more application programs 36, a driver library 37 constructed in accordance with one embodiment of the present invention, and program data 38. A user may enter commands and information into the personal computer 20 through a keyboard 40 and pointing device, such as a mouse 42. Other input devices (not shown) may include a microphone, joystick, game pad, satellite dish, scanner, or the like. These and other input devices are often connected to the processing unit 21 through a serial port interface 46 that is coupled to the system bus, but may be connected by other interfaces, such as a game port or a universal serial bus (USB). A monitor 47 or other type of display device is also connected to the system bus 23 via an interface, such as a video adapter 48. In addition to the monitor, personal computers typically include other peripheral output devices (not shown), such as speakers or printers.

The personal computer 20 may operate in a networked environment using logical connections to one or more remote computers, such as a remote computer 49. The remote computer 49 may be a server, a router, a peer device or other common network node, and typically includes many or all of the elements described relative to the personal computer 20, although only a memory storage device 50 has been illustrated in Fig. 1. The logical connections depicted in Fig. 1 include a local area network (LAN) 51 and a wide area network (WAN) 52. Such networking environments are commonplace in offices, enterprise-wide computer networks, intranets and the Internet.

When used in a LAN networking environment, the personal computer 20 is connected to the LAN 51 through a network interface 53. When used in a WAN networking environment, the personal computer 20 typically includes a modem 54 or other means for establishing communications over the WAN 52, such as the Internet. The modem 54, which may be internal or external, is connected to the system bus 23 via the serial port interface 46. In a networked environment, program modules depicted relative to the personal computer 20, or portions thereof, may be stored in the remote memory storage device. It will be appreciated that the network connections shown are exemplary and other means of establishing a communications link between the computers may be used.

FIGURE 2 is a functional block diagram of software components embodying the present invention resident on the computer 20 of FIGURE 1. Illustrated is a management system 200, including multiple management applications 201 executing in user mode 203. The management system 200 may be any CIM schema compliant management system, such as the WMI management system described above. Although embodiments of the present invention may be described here in cooperation with the WMI management system, the present invention is equally applicable to other management systems. Reference here to the WMI management system is for illustrative purposes only, and does not limit the applicability of the invention.

Interfacing with the management applications 201 is a WMI agent 207. The WMI agent 207 maintains and provides access to a WMI store 209, which is a database containing the management information exposed by the management system 200. The management information contained in the WMI store 209 comes from multiple providers, such as components 211, 212, and 213. The providers act as intermediaries between the WMI agent 207 and one or more managed objects. When the WMI agent 207 receives a request from a management application 201 for information that is not available from the WMI store 209, or for notification of events that are unsupported, the WMI agent 207 forwards the request to an appropriate provider. That provider then supplies the information or event notification requested.

One such provider is the WMI Extensions to Windows Driver Model ("XWDM") provider (the "WMI provider") 214. The WMI provider 214 includes two parts: a user mode component ("UM component") 215 and a kernel mode component ("KM component") 217. The UM component 215 communicates with the KM component 217 to pass messages between the user mode 203 and the kernel mode 219. The WMI provider 214 allows instrumented devices to make management information available to the management system 200, and hence management applications 201, by providing a pipeline between the user mode 203 and the kernel mode 219.

In kernel mode 219, several device drivers, such as driver 221 and driver 222, support their associated devices, such as device 223 and device 224, respectively, and pass information to the management system 200 via the WMI provider 214. The drivers operate in conjunction with the management system 200 to allow the management applications to query or set management information within the several instrumented devices. In addition to queries and sets, the management system allows WMI method calls, which are functionally equivalent to an I/O control ("IOCTL") call to a device.

The WMI provider 214 and the device drivers 221, 222 communicate by passing I/O Request Packets ("IRP") 227. The IRPs 227 are instructions to perform actions related to the operation of the management system 200. For instance, a particular IRP 227 may instruct the driver 221 to begin collecting data on its associated device 223. Another IRP 227 may instruct the driver 221 to end collecting that data. Several of the IRPs used by the WMI management system are detailed in the attached appendix, and are incorporated herein by reference for illustrative purposes only.

Also illustrated is a driver library 37 constructed in accordance with the present invention. The driver library 37, named "WMILIB" in this example, is a kernel mode software library that includes software routines that would ordinarily be included in each of multiple device drivers, such as both in driver 221 and driver 222. The kernel mode device drivers, such as driver 221, may call the driver library 37 to request that many routine functions be performed by the driver library 37 rather than by the individual device drivers. The driver library 37 may also call back to the kernel mode drivers and request certain device-specific information, performance or request a specific action. The interaction of the WMI provider 214, the kernel mode device drivers, and the driver library 37 is illustrated in FIGURE 3 and described in detail below.

FIGURE 3 is a functional block diagram illustrating in greater detail the interaction between the WMI provider 214, the kernel mode device drivers, and the driver library 37 to achieve the benefits of the present invention. To begin, the WMI provider 214 issues an IRP to a kernel mode device driver, such as IRP 301 to driver 221. IRP 301 may be an instruction to set data within the device 223 associated with the driver 221, it may be an instruction to retrieve data, or it may be an instruction for the driver 221 to cause the device 223 to perform some function. The code that would ordinarily handle the IRP 301 is typical code 302 that also resides in each of several other kernel mode device drivers, such as driver 222. However, in accordance with this embodiment of the invention, the typical code 302 actually resides in the driver library 37 rather than in the separate kernel mode device drivers. For that reason, rather than handle the IRP 301 directly, the driver 221 passes the IRP 301 to the driver library 37. The driver library 37 of this embodiment is accessible to the other drivers by way of several Application Programming Interface ("API") calls. Exemplary API calls used in connection with the WMI management system are described in detail in the attached appendix, and are incorporated herein by reference for illustrative purposes only.

In this manner, the driver library 37 may perform many functions that otherwise would be performed by the several kernel mode device drivers. However, the device drivers may

also require some unique code, such as the unique code 307 associated with the driver 221 or the unique code 309 associated with the driver 222. It should be noted that unique code 307 is different from unique code 309. For example, unique code 307 may provide access to data registers or other features associated with the device 223, but which are inapplicable to another device, such as device 224. Consequently, each device driver maintains that software code necessary for interfacing to its associated device.

To handle the IRP 301, the driver library 37 may require access to the unique code 307, 309 maintained by the device drivers. For example, to handle the IRP 301, the driver library 37 may require access to data stored in a register on the device 223 itself. In that case, the driver library 37 may call back to the driver 221 to execute the unique code 307 and retrieve the requested data or perform an action. Exemplary callback routines used in connection with the WMI management system are described in detail in the attached appendix, and are incorporated herein by reference for illustrative purposes only.

FIGURE 4 is a functional block diagram illustrating an alternative embodiment of the present invention as it may be applied to a driver 222 that contains multiple drivers. In this embodiment, driver 222 is actually a driver stack, and includes more than one driver acting in concert to support the same device 224. One example of a driver stack may be a driver intended to interface with a SCSI device. Such a driver may employ both a SCSI port driver 401 and a SCSI miniport driver 403. The SCSI miniport driver 403 is a special kind of device driver designed to work in conjunction with the SCSI port driver 401 to support a SCSI device, such as device 224. The SCSI port driver 401 supplies the interface to the operating system 35 and some common code, while the SCSI miniport driver 403 contains any hardware specific code.

As is known to those skilled in the art, the SCSI miniport driver 403 cannot call code other than the SCSI port driver 401, and, for that reason, is unable to access the driver library 37 dynamically. Moreover, if the SCSI miniport driver 403 were modified to call the SCSI port driver 401 for functions similar to those provided by the driver library 37, then the SCSI miniport driver 403 would be unable to interface with earlier versions of the SCSI port driver 401. For those reasons, this embodiment of the invention provides a static driver library 37', rather than a dynamic library, that is incorporated into the SCSI miniport driver 403 at link time. The code from the driver library 37 is included in the SCSI miniport driver 403 as a static driver library 37', and the SCSI miniport driver 403 may directly access any necessary routines from the static driver library 37'.

As depicted in FIGURE 4, the management system 200 issues to the driver 222 an IRP 411. The SCSI port driver 401 receives the IRP 411 and first determines whether the

IRP 411 is intended for it. If the SCSI port driver 401 is intended to handle the IRP 411, then it does so. If not, then the SCSI port driver 401 translates the IRP 411 to a SCSI Request Block ("SRB") 413, which is a message format used with SCSI drivers, and passes the SRB 413 to the SCSI miniport driver 403. If the SRB 413 includes instructions that involve executing code related to the management system 200, the SCSI miniport driver 403 may call the static driver library 37' incorporated in the SCSI miniport driver 403. That configuration allows the SCSI miniport driver 403 to take advantage of the driver library 37 even though the SCSI miniport driver 403 cannot dynamically link to the driver library 37.

FIGURE 5 is an event trace illustrating the management system 200 supporting a driver constructed in accordance with the present invention. The event trace begins at step 501 when the management system 200 issues an IRP to the driver 221. The first IRP may be a simple request for data or other action that the driver can handle directly. For example, the first IRP may be a simple request for data which the driver can handle directly. For instance, the driver may be a filter driver configured to intercept IRPs intended for another driver, and which handles those intercepted IRPs directly. The code in the driver 221 may not need assistance to handle that IRP, and consequently, at step 502, the driver 221 handles the IRP directly and performs the requested action. The driver 221 may also return any requested data to the management system 200.

At step 503, the management system 200 may issue a second IRP to the driver 221. Unlike the first IRP, the second IRP may require additional input beyond the scope of the code within the driver 221. In that case, at step 504, the driver 221 passes a message to the driver library 37 identifying the particular IRP. In this case, it is possible that the driver library 37 can handle the second IRP without further intervention by the driver 221, and consequently, at step 505, the driver library 37 performs the action requested by the IRP on behalf of the driver and without further assistance of the driver. For example, the driver library 37 may return any data requested by the management system 200. Alternatively, the return may be simply an indication that the IRP has been handled.

At step 506, the management system 200 issues a third IRP to the driver 221. As with the second IRP, the driver 221 does not handle the particular IRP. Accordingly, as with the second IRP, the driver 221 passes the IRP to the driver library 37. However, unlike the second IRP, to handle the third IRP, the driver library 37 requires some subaction from the driver 221. For example, the IRP may request data stored within the device 223 and which must be retrieved using unique code 307 within the driver 221. Accordingly, at step 508, the driver library 37 may issue a callback to the driver 221 requesting that it perform some subaction, such as retrieving the data stored on the device 223. At step 509, the driver 221

performs the requested subaction. For instance, the driver 221 may execute the unique code 307 to retrieve the requested data and return, at step 509, that data to the driver library 37. The driver library 37 may then format that data in a way that the management system 200 expects, and finally complete the requested action at step 510. In this example, completing the requested action may involve returning the retrieved data to the management system 200.

FIGURE 6 is a logical flow diagram illustrating a process performed by one embodiment of the present invention to make use of the driver library 37 described above. The process begins at starting block 601, where the management system 200 begins to generate an instruction for a device driver, such as the driver 223. Processing continues at block 602.

At block 602, the management system 200 issues an IRP to the first driver in a driver stack. As mentioned above, a single device, such as device 223, may be serviced by a driver stack containing more than one device driver working in conjunction (called a "driver stack"). When an IRP is directed at information associated with a particular device, the IRP may actually be intended for a particular device driver in a driver stack, and should identify for which device driver in the stack the IRP is intended. Consequently, the management system 200 issues the IRP to the highest level driver (identified here as the first driver) in the driver stack, and processing continues at decision block 604

At decision block 604, the current driver identifies whether the IRP is intended for that driver. The current driver may make that determination by comparing an identifier stored in the IRP to an identifier associated with the driver. If the IRP is not intended for the current driver, processing proceeds to block 606 where the IRP is passed to the next driver in the stack and decision block 604 is repeated. It should be noted that there may be only a single driver in the stack, in which case the IRP should be intended for that driver. If the IRP is intended for the current driver, processing proceeds to block 608.

At block 608, after the intended driver has been determined, that driver may pass the IRP to the driver library 37. As discussed above, it is not necessary to the proper operation of the present invention that a driver pass all IRPs to the driver library 37. As discussed above, developers of device drivers may choose to include code in the driver to handle particular IRPs, while calling the driver library 37 for others. Therefore, at block 608, it is envisioned that any IRPs not chosen to be handled directly by the driver be passed to the driver library 37. Processing then proceeds to decision block 610.

At decision block 610, the driver library 37 identifies whether the particular IRP requires data from or further action by the calling driver. For example, if the IRP is a request for particular data only available through the driver, the driver library 37 may decide to call

back to the driver for that information. At block 612, if any such information or input is required, the driver library 37 calls the driver for that information, and at decision block 610, the driver library 37 again determines whether further information is required. After receiving from the driver any additional information required to service the IRP, processing proceeds to block 614.

At block 614, the driver library 37 executes the routines necessary to service the particular IRP. Many varying routines and functions may be performed to handle the particular IRP. For example, an IRP may be issued requesting that data values be changed. However, if the driver does not support changing data values then the driver library 37 may return an error without the involvement of the driver. Another IRP may be issued requesting the driver library 37 to return all data associated with a driver, or a single instance of data associated with a particular device, such as device 223. As mentioned above, servicing the IRP may require actions from the driver in the form of data queries or sets related to the device. Likewise, the IRP may be a request to execute a method associated with data exposed by the driver. These examples are provided to illustrate the nature of the functionality of the driver library 37, and those skilled in the art will appreciate that many other functions and routines may be provided within the driver library 37. When the IRP has been handled, processing terminates at block 616.

FIGURE 7 is a logical flow diagram illustrating steps performed by a process for generating an event message through the use of driver library 37. The process begins at starting step 701, where an instrumented device 223 generates a notification that an event has occurred at the device 223. For example, if the device 223 is a temperature sensor, the event may be that the temperature of the computer 20 exceeds a given threshold. The process then continues at block 703.

At block 703, the device 223 issues a notification of the occurrence of the event to the driver 221. The notification of the event may take the form of an interrupt or other acceptable notification mechanism. Processing proceeds to block 705.

At block 705, the driver 221 passes to the driver library 37 the notification of the event with a request to handle that notification. For example, handling the event may include generating a properly-formatted message for issuance to the management system 200. In addition, handling the event may include retrieving from the device 223 certain data associated with the event. Accordingly, to simply the burden on the driver 221 of handling the event, common functions for data formatting and message generation may be stored within the driver library 37 and called to assist in handling the event. Processing continues at block 707.

At block 707, the driver library 37 may optionally call back to the driver 221 to retrieve any data associated with the event, such as a temperature value from a register within the device 223. The unique code 307 within the driver 221 may be invoked to retrieve and pass that data to the driver library 37. Any function provided by the unique code 307 may be invoked by the driver library 37. Processing continues at block 709.

At block 709, the driver library 37 may format any retrieved data in a buffer to be passed to the management system 200 along with an event notification message. For example, the management system 200 may expect data to be in a common format when passed with an event notification method. Code for constructing that common format may reside within the driver library 37, and therefore the data passed from the driver 221 may be raw, unformatted data. Processing continues at block 711.

At block 711, the driver library 37 issues to the management system 200 the event message constructed at block 709. Processing then terminates at ending block 713.

While the preferred embodiment of the invention has been illustrated and described, it will be appreciated that various changes can be made therein without departing from the spirit and scope of the invention.

Kernel-Mode Drivers Preliminary Windows 2000 DDK

Chapter 1 WMI IRPs

[This is preliminary documentation and subject to change]

This chapter describes the Windows Management Instrumentation IRPs that are part of the WMI extensions to WDM All WMI IRPs use the major code IRP_MJ_SYSTEM_CONTROL and a minor code that indicates the specific WMI request The WMI kernel-mode component can send WMI IRPs any time following a driver's successful registration as a supplier of WMI data WMI IRPs typically get sent when a user-mode data consumer has requested WMI data

All drivers must set a dispatch table entry point that can be used by a DispatchSystemControl routine to handle WMI requests If a driver registers as a WMI data provider by calling **IoWMIRegistrationControl**, it must handle such requests in one of the following ways

- Call the kernel-mode WMI library routines declared in the *wmilib h* header file Drivers can use these routines only if they base static instance names on a single base name string or the device instance ID of a PDO Drivers that use dynamic instance names can not use the WMI library routines
- Process and complete any request that was tagged with a pointer to the driver's device object Such a request is passed by the driver in its call to **IoWMIRegistrationControl** Other IRP_MJ_SYSTEM_CONTROL requests must be forwarded to the next-lower driver

The WMI library routines simplify the handling of WMI requests Instead of processing each WMI request a driver calls **WmiSystemControl** with a pointer to its device object, the IRP, and a WMILIB_CONTEXT structure This WMILIB_CONTEXT structure contains pointers to a set of DpWmi*Xxx* callback routines that are defined by the driver The WMI library validates the IRP parameters and calls the driver provided DpWmi*Xxx* routine for driver-specific processing WMI library then packages any output in an appropriate WNODE_*XXX* structure The output and status are returned to the caller Drivers that use dynamic instance names must handle WMI requests by filling in the WNODE_*XXX* structure directly

Drivers that do not register as WMI data providers must forward all WMI requests to the next-lower driver

For information about registering as a WMI data provider, handling WMI IRPs, and using the WMI kernel-mode library routines see the *Kernel-Mode Drivers Design Guide*

Built on Tuesday June 15 1999

Kernel-Mode Drivers Preliminary Windows 2000 DDK

IRP_MN_CHANGE_SINGLE_INSTANCE

[This is preliminary documentation and subject to change]

All drivers that support WMI must handle this IRP

When Sent

WMI sends this IRP to change all data items in a single instance of a data block

WMI sends this IRP at IRQL PASSIVE_LEVEL in an arbitrary thread context

Input

Parameters.WMI.ProviderId points to the device object of the driver that should respond to the request This pointer is found in the driver's I/O stack location in the IRP

Parameters.WMI.DataPath points to a GUID that identifies the data block associated with the instance to be changed

Parameters.WMI.BufferSize indicates the size of the nonpaged buffer at Parameters WMI Buffer

Parameters.WMI.Buffer points to a WNODE_SINGLE_INSTANCE structure that identifies the instance and specifies new data values

Output

None

I/O Status Block

If the driver handles the IRP by calling **WmiSystemControl**, WMI sets **Irp->IoStatus.Status** and **Irp->IoStatus.Information** in the I/O status block

Otherwise, the driver sets **Irp->IoStatus.Status** to STATUS_SUCCESS or to an appropriate error status such as the following

STATUS_WMI_INSTANCE_NOT_FOUND

STATUS_WMI_GUID_NOT_FOUND

STATUS_WMI_READ_ONLY

STATUS_WMI_SET_FAILURE

On success, the driver sets **Irp->IoStatus.Information** to zero

Operation

A driver that handles WMI IRPs by calling WMI library support routines calls **WmiSystemControl** with a pointer to its WMILIB_CONTEXT structure a pointer to its device object and a pointer to the

APPENDIX

IRP WmiSystemControl calls the driver's DpWmiSetDataBlock routine, or returns STATUS_WMI_READ_ONLY to the caller if the driver does not define an entry point for such a routine

A driver that handles an IRP_MN_CHANGE_SINGLE_INSTANCE request does so only if the device object pointer at **Parameters.WMI.ProviderId** matches the pointer passed by the driver in its call to **IoWMIRegistrationControl**. Otherwise the driver forwards the request to the next-lower driver

If the driver handles the request it first checks the GUID at **Parameters.WMI.DataPath** to determine whether it identifies a data block supported by the driver. If not, the driver fails the IRP and returns STATUS_WMI_GUID_NOT_FOUND

If the driver supports the data block it checks the input WNODE_SINGLE_INSTANCE at **Parameters.WMI.Buffer** for the instance name as follows

- If WNODE_FLAG_STATIC_INSTANCE_NAMES is set in **WnodeHeader.Flags** the driver uses **InstanceIndex** as an index into the driver's list of static instance names for that block. WMI obtains the index from registration data provided by the driver when it registered the block
- If WNODE_FLAG_STATIC_INSTANCE_NAMES is clear in **WnodeHeader.Flags**, the driver uses the offset at **OffsetInstanceName** to locate the instance name string in the input WNODE_SINGLE_INSTANCE. **OffsetInstanceName** is the offset in bytes from the beginning of the structure to a USHORT which is the length of the instance name string in bytes (not characters), including the NUL terminator if present followed by the instance name string in Unicode

If the driver cannot locate the specified instance, it must fail the IRP and return a STATUS_WMI_INSTANCE_NOT_FOUND. In the case of an instance that has a dynamic instance name this status indicates that the driver does not "own" the instance. WMI can therefore continue to query other data providers and return an appropriate error to the data consumer if another provider finds the instance but cannot handle the request for some other reason

If the driver locates the instance and can handle the request, it sets the read/write data items in the instance to the values in the WNODE_SINGLE_INSTANCE, leaving any read-only items unchanged. If the entire data block is read-only, the driver should fail the IRP and return STATUS_WMI_READ_ONLY

If the instance is valid but the driver cannot handle the request, it can return any appropriate error status

See Also

DpWmiSetDataBlock, **IoWMIRegistrationControl**, WMILIB_CONTEXT, **WmiSystemControl**, WNODE_SINGLE_INSTANCE

Built on Tuesday June 15, 1999

Kernel-Mode Drivers Preliminary Windows 2000 DDK

IRP_MN_CHANGE_SINGLE_ITEM

[This is preliminary documentation and subject to change]

All drivers that support WMI must handle this IRP

When Sent

WMI sends this IRP to change a single data item in a single instance of a data block

WMI sends this IRP at IRQL PASSIVE_LEVEL in an arbitrary thread context

Input

Parameters.WMI.ProviderId points to the device object of the driver that should respond to the request. This pointer is located in the driver's I/O stack location in the IRP

Parameters.WMI.DataPath points to a GUID that identifies the data block to be set

Parameters.WMI.BufferSize indicates the size of the nonpaged buffer at Parameters.WMI.Buffer

Parameters.WMI.Buffer points to a WNODE_SINGLE_ITEM structure that identifies the instance of the data block the ID of the item to set and a new data value

Output

None

I/O Status Block

If the driver handles the IRP by calling **WmiSystemControl** WMI sets **Irp->IoStatus.Status** and **Irp->IoStatus.Information** in the I/O status block

Otherwise, the driver sets **Irp->IoStatus.Status** to STATUS_SUCCESS or to an appropriate error status such as the following

STATUS_WMI_INSTANCE_NOT_FOUND

STATUS_WMI_INSTANCE_ID_NOT_FOUND

STATUS_WMI_GUID_NOT_FOUND

STATUS_WMI_READ_ONLY

STATUS_WMI_SET_FAILURE

On success a driver sets **Irp->IoStatus.Information** to zero

Operation

A driver that handles WMI IRPS by calling WMI library support routines calls **WmiSystemControl** with a pointer to its WMILIB_CONTEXT structure, a pointer to its device object, and a pointer to the IRP. **WmiSystemControl** calls the driver's DpWmiSetDataItem routine, or returns STATUS_WMI_READ_ONLY to the caller if the driver does not define an entry point for such a routine

A driver should handles an IRP_MN_CHANGE_SINGLE_ITEM request only if **Parameters.WMI.ProviderId** points to the same device object as the pointer that the driver passed to **IoWMIRegistrationControl** Otherwise the driver forwards the request to the next-lower driver

Before handling a request the driver determines whether **Parameters.WMI.DataPath** points to a GUID that the driver supports If it does not, the driver fails the IRP and returns STATUS_WMI_GUID_NOT_FOUND

If the driver supports the data block, it checks the input WNODE_SINGLE_ITEM structure that **Parameters.WMI.Buffer** points to for the instance name, as follows

- If WNODE_FLAG_STATIC_INSTANCE_NAMES is set in **WnodeHeader.Flags** the driver uses **InstanceIndex** as an index into the driver's list of static instance names for that block WMI obtains the index from registration data provided by the driver when it registered the block
- If WNODE_FLAG_STATIC_INSTANCE_NAMES is clear in **WnodeHeader.Flags**, the driver uses the offset at **OffsetInstanceName** to locate the instance name string in the input WNODE_SINGLE_ITEM **OffsetInstanceName** is the offset in bytes from the beginning of the structure to a USHORT which is the length of the instance name string in bytes (not characters) This length includes the NULL terminator if present followed by the instance name string in Unicode

If the driver cannot locate the specified instance it must fail the IRP and return STATUS_WMI_INSTANCE_NOT_FOUND In the case of an instance with a dynamic instance name this status indicates that the driver does not "own" the instance WMI can therefore continue to query other data providers and return an appropriate error to the data consumer if another provider finds the instance but cannot handle the request for some other reason

If the driver locates the instance and can handle the request, it sets the data item in the instance to the value in the WNODE_SINGLE_ITEM If the data item is read-only the driver leaves the item unchanged fails the IRP and returns STATUS_WMI_READ_ONLY

If the instance is valid but the driver cannot handle the request, it can return any appropriate error status

See Also

DpWmiSetDataItem **IoWMIRegistrationControl**, WMILIB_CONTEXT, **WmiSystemControl**

WNODE_SINGLE_ITEM

Built on Tuesday, June 15, 1999

Kernel-Mode Drivers Preliminary Windows 2000 DDK

IRP_MN_DISABLE_COLLECTION

[This is preliminary documentation and subject to change]

Any WMI driver that registers one or more of its data blocks as expensive to collect must handle this IRP

When Sent

WMI sends this IRP to request the driver to stop accumulating data for a data block that the driver registered as expensive to collect and for which data collection has been enabled

WMI sends this IRP at IRQL PASSIVE_LEVEL in an arbitrary thread context

Input

Parameters.WMI.ProviderId points to the device object of the driver that should respond to the request This pointer is located in the driver's I/O stack location in the IRP

Parameters.WMI.DataPath points to a GUID that identifies the data block for which data accumulation should be stopped

Output

None

I/O Status Block

If the driver handles the IRP by calling **WmiSystemControl** WMI sets **Irp->IoStatus.Status** and **Irp->IoStatus.Information** in the I/O status block

Otherwise, the driver sets **Irp->IoStatus.Status** to STATUS_SUCCESS or to an appropriate error status such as the following

STATUS_WMI_GUID_NOT_FOUND

STATUS_INVALID_DEVICE_REQUEST

On success, a driver sets **Irp->IoStatus.Information** to zero

Operation

A driver registers a data block as expensive to collect by setting WMIREG_FLAG_EXPENSIVE in the **Flags** member of the WMIREGGUID or WMIGUIDREGINFO structure that the driver passes to WMI when it registers or updates the data block. A driver need not accumulate data for such a block until it receives an explicit request to enable collection.

A driver that handles WMI IRPs by calling WMI library support routines calls **WmiSystemControl** with a pointer to its WMILIB_CONTEXT structure, a pointer to its device object, and a pointer to the IRP. **WmiSystemControl** calls the driver's DpWmiFunctionControl routine, or simply returns STATUS_SUCCESS to the caller if the driver does not define an entry point for such a routine.

A driver handles an IRP_MN_DISABLE_COLLECTION request only if **Parameters.WMI.ProviderId** points to the same device object as the pointer that the driver passed to **IoWMIRegistrationControl**. Otherwise, the driver forwards the request to the next-lower driver.

Before handling the request, the driver determines whether **Parameters.WMI.DataPath** points to a GUID that the driver supports. If not, the driver fails the IRP and returns STATUS_WMI_GUID_NOT_FOUND. If the data block is valid but was not registered with WMIREG_FLAG_EXPENSIVE, the driver can return STATUS_SUCCESS and take no further action.

It is unnecessary for the driver to check whether data collection is already disabled because WMI sends a single disable request for the data block when the last data consumer disables collection for that block. WMI will not send another disable request without an intervening request to enable.

See Also

DpWmiFunctionControl, **IoWMIRegistrationControl**, IRP_MN_ENABLE_COLLECTION, WMILIB_CONTEXT, WMIREGGUID, WMIGUIDREGINFO, **WmiSystemControl**

Built on Tuesday, June 15, 1999

Kernel-Mode Drivers: Preliminary Windows 2000 DDK

IRP_MN_DISABLE_EVENTS

[This is preliminary documentation and subject to change.]

Any WMI driver that registers one or more event blocks must handle this IRP.

When Sent

WMI sends this IRP to inform the driver that a data consumer has requested no further notification of an event.

WMI sends this IRP at IRQL PASSIVE_LEVEL in an arbitrary thread context.

Input

Parameters.WMI.ProviderId points to the device object of the driver that should respond to the request. This pointer is located in the driver's I/O stack location in the IRP.

Parameters.WMI.DataPath points to a GUID that identifies the event block to disable.

Output

None

I/O Status Block

If the driver handles the IRP by calling **WmiSystemControl**, WMI sets **Irp->IoStatus.Status** and **Irp->IoStatus.Information** in the I/O status block.

Otherwise, the driver sets **Irp->IoStatus.Status** to STATUS_SUCCESS or to an appropriate error status such as the following:

STATUS_WMI_GUID_NOT_FOUND

STATUS_INVALID_DEVICE_REQUEST

On success, a driver sets **Irp->IoStatus.Information** to zero.

Operation

A driver that handles WMI IRPs by calling WMI library support routines calls **WmiSystemControl** with a pointer to its WMILIB_CONTEXT structure, a pointer to its device object, and a pointer to the IRP. **WmiSystemControl** calls the driver's DpWmiFunctionControl routine, or simply returns STATUS_SUCCESS to the caller if the driver does not define an entry point for such a routine.

A driver handles an IRP_MN_DISABLE_EVENTS request only if **Parameters.WMI.ProviderId** points to the same device object as the pointer that the driver passed to **IoWMIRegistrationControl**. Otherwise, the driver forwards the request to the next-lower driver.

Before handling a request, the driver determines whether **Parameters.WMI.DataPath** points to a GUID the driver supports. If not, the driver fails the IRP and returns STATUS_WMI_GUID_NOT_FOUND.

If the driver supports the event block, it disables the event for all instances of that block.

It is unnecessary for the driver to check whether events are already disabled for the event block because WMI sends a single disable request for that event block when the last data consumer disables the event. WMI will not send another disable request without an intervening request to enable.

For details about defining event blocks, see the *Kernel-Mode Drivers Design Guide*.

See Also

DpWmiFunctionControl, **IoWMIRegistrationControl**, IRP_MN_ENABLE_EVENTS WMILIB_CONTEXT, **WmiSystemControl**

Built on Tuesday, June 15, 1999

Kernel-Mode Drivers. Preliminary Windows 2000 DDK

IRP_MN_ENABLE_COLLECTION

[This is preliminary documentation and subject to change]

Any WMI driver that registers one or more of its data blocks as expensive to collect must handle this IRP

When Sent

WMI sends this IRP to request the driver to start accumulating data for a data block that the driver registered as expensive to collect

WMI sends this IRP at IRQL PASSIVE_LEVEL in an arbitrary thread context

Input

Parameters.WMI.ProviderId points to the device object of the driver that should respond to the request This pointer is located in the driver's I/O stack location in the IRP

Parameters.WMI.DataPath points to a GUID that identifies the data block for which data is accumulated

Output

None

I/O Status Block

If the driver handles the IRP by calling **WmiSystemControl**, WMI sets **Irp->IoStatus.Status** and **Irp->IoStatus.Information** in the I/O status block

Otherwise, the driver sets **Irp->IoStatus.Status** to STATUS_SUCCESS or to an appropriate error status such as the following

STATUS_WMI_GUID_NOT_FOUND

STATUS_INVALID_DEVICE_REQUEST

On success a driver sets **Irp->IoStatus.Information** to zero

Operation

A driver registers a data block as expensive to collect by setting WMIREG_FLAG_EXPENSIVE in the **Flags** member of the WMIREGGUID or WMIGUIDREGINFO structure The driver passes these structures to WMI when it registers or updates the data block A driver need not accumulate data for such a block until it receives an explicit request to start data collection.

A driver that handles WMI IRPs by calling WMI library support routines calls **WmiSystemControl** with a pointer to its WMILIB_CONTEXT structure, a pointer to its device object, and a pointer to the IRP **WmiSystemControl** calls the driver's DpWmiFunctionControl routine, or simply returns STATUS_SUCCESS to the caller if the driver does not define an entry point for such a routine

A driver handles an IRP_MN_ENABLE_COLLECTION request only if **Parameters.WMI.ProviderId** points to the same device object as the pointer that the driver passed to **IoWMIRegistrationControl** Otherwise, the driver forwards the request to the next-lower driver

Before handling a request, the driver should make sure that **Parameters.WMI.DataPath** points to a GUID that the driver supports If it does not, the driver should fails the IRP and return STATUS_WMI_GUID_NOT_FOUND If the data block is valid but was not registered with WMIREG_FLAG_EXPENSIVE, the driver can return STATUS_SUCCESS and take no further action

If the block is valid and was registered with WMIREG_FLAG_EXPENSIVE, the driver enables data collection for all instances of that data block

It is unnecessary for the driver to check whether data collection is already enabled for the data block WMI sends only a single request to enable a data block after the first data consumer enables the block WMI will not send another request to enable without an intervening disable request

See Also

DpWmiFunctionControl **IoWMIRegistrationControl**, IRP_MN_DISABLE_COLLECTION WMILIB_CONTEXT, WMIREGGUID, **WmiSystemControl**

Built on Tuesday, June 15, 1999

Kernel-Mode Drivers Preliminary Windows 2000 DDK

IRP_MN_ENABLE_EVENTS

[This is preliminary documentation and subject to change]

Any WMI driver that registers one or more event blocks must handle this IRP

When Sent

WMI sends this IRP to inform the driver that a data consumer has requested notification of an event

WMI sends this IRP at IRQL PASSIVE_LEVEL in an arbitrary thread context

Input

Parameters.WMI.ProviderId points to the device object of the driver that should respond to the request This pointer is located in the driver's I/O stack location in the IRP

Parameters.WMI.DataPath points to a GUID that identifies the event block to enable

Parameters.WMI.BufferSize indicates the size of the nonpaged buffer at **Parameters.WMI.Buffer**, which must be greater than or equal to the sizeof WNODE_HEADER A driver that does not register trace blocks (WMIREG_FLAG_TRACED_GUID) can ignore this parameter

Parameters.WMI.Buffer points to a WNODE_HEADER that indicates whether the event should be traced (WMI_FLAGS_TRACED_GUID) and provides a handle to the system logger A driver that does not register trace blocks (WMIREG_FLAG_TRACED_GUID) can ignore this parameter

Output

None

I/O Status Block

If the driver handles the IRP by calling **WmiSystemControl** WMI sets **Irp->IoStatus.Status** and **Irp->IoStatus.Information** in the I/O status block

Otherwise the driver sets **Irp->IoStatus.Status** to STATUS_SUCCESS or to an appropriate error status such as the following

STATUS_WMI_GUID_NOT_FOUND

STATUS_INVALID_DEVICE_REQUEST

On success a driver sets **Irp->IoStatus.Information** to zero

Operation

A driver that handles WMI IRPs by calling WMI library support routines calls **WmiSystemControl** with a pointer to its WMILIB_CONTEXT structure a pointer to its device object, and a pointer to the IRP **WmiSystemControl** calls the driver's DpWmiFunctionControl routine or simply returns STATUS_SUCCESS to the caller if the driver does not define an entry point for such a routine

A driver handles an IRP_MN_ENABLE_EVENTS request only if **Parameters.WMI.ProviderId** points to the same device object as the pointer that the driver passed to **IoWMIRegistrationControl** Otherwise the driver forwards the request to the next-lower driver

Before the driver handles the request, it should determine whether **Parameters.WMI.DataPath**

points to a GUID that the driver supports If not the driver fails the IRP and returns STATUS_WMI_GUID_NOT_FOUND

If the driver supports the event block it enables the event for all instances of that data block

It is unnecessary for the driver to check whether events are already enabled for the event block because WMI sends a single request to enable for the event block when the first data consumer enables the event WMI will not send another request to enable without an intervening disable request

A driver that registers trace blocks (WMIREG_FLAG_TRACED_GUID) must also determine whether to send the event to WMI or to the system logger for tracing If tracing is requested **Parameters.WMI.Buffer** points to a WNODE_HEADER structure in which **Flags** is set with WNODE_FLAG_TRACED_GUID and **HistoricalContext** contains a handle to the logger

For details about defining event blocks sending events and tracing see the *Kernel-Mode Drivers Design Guide*

See Also

DpWmiFunctionControl **IoWMIRegistrationControl** IRP_MN_DISABLE_EVENTS WMILIB_CONTEXT, **WmiSystemControl** WNODE_EVENT_ITEM WNODE_HEADER

Built on Tuesday June 15 1999

Kernel-Mode Drivers Preliminary Windows 2000 DDK

IRP_MN_EXECUTE_METHOD

[This is preliminary documentation and subject to change]

All drivers that support methods within data blocks must handle this IRP

When Sent

WMI sends this IRP to execute a method associated with a data block

WMI sends this IRP at IRQL PASSIVE_LEVEL in an arbitrary thread context

WMI will send an IRP_MN_QUERY_SINGLE_INSTANCE prior to sending an IRP_MN_EXECUTE_METHOD If a driver supports IRP_MN_EXECUTE_METHOD it must have a IRP_MN_QUERY_SINGLE_INSTANCE handler for the same data block whose method is being executed

Input

Parameters.WMI.ProviderId points to the device object of the driver that should respond to the request This pointer is located in the driver's I/O stack location in the IRP

Parameters.WMI.DataPath points to a GUID that identifies the data block associated with the method to execute

Parameters.WMI.BufferSize indicates the size of the nonpaged buffer at **Parameters.WMI.Buffer** which must be >= **sizeof**(WNODE_METHOD_ITEM) plus the size of any output data for the method

Parameters.WMI.Buffer points to a WNODE_METHOD_ITEM structure in which **MethodID** indicates the identifier of the method to execute and **DataBlockOffset** indicates the offset in bytes from the beginning of the structure to the first byte of input data, if any. **Parameters.WMI.Buffer->SizeDataBlock** indicates the size in bytes of the input WNODE_METHOD_ITEM including input data, or zero if there is no input

Output

If the driver handles WMI IRPs by calling **WmiSystemControl**, WMI fills in the WNODE_METHOD_ITEM with data returned by the driver's DpWmiExecuteMethod routine

Otherwise the driver fills in the WNODE_METHOD_ITEM structure that **Parameters.WMI.Buffer** points to as follows

- Updates **WnodeHeader.BufferSize** with the size of the output WNODE_METHOD_ITEM including any output data
- Updates **SizeDataBlock** with the size of the output data, or zero if there is no output data
- Checks **Parameters.WMI.Buffersize** to determine whether the buffer is large enough to receive the output WNODE_METHOD_ITEM including any output data. If the buffer is not large enough, the driver fills in the needed size in a WNODE_TOO_SMALL structure pointed to by **Parameters.WMI.Buffer**. If the buffer is smaller than sizeof WNODE_TOO_SMALL, the driver fails the IRP and returns STATUS_BUFFER_TOO_SMALL.
- Writes output data, if any, over input data starting at **DataBlockOffset**. The driver must not change the input value of **DataBlockOffset**

I/O Status Block

If the driver handles the IRP by calling **WmiSystemControl**, WMI sets **Irp->IoStatus.Status** and **Irp->IoStatus.Information** in the I/O status block

Otherwise, the driver sets **Irp->IoStatus.Status** to STATUS_SUCCESS or to an appropriate error status such as the following

STATUS_BUFFER_TOO_SMALL

STATUS_WMI_GUID_NOT_FOUND

STATUS_WMI_INSTANCE_NOT_FOUND

STATUS_WMI_ITEM_ID_NOT_FOUND

On success, a driver sets **Irp->IoStatus.Information** to the number of bytes written to the buffer at **Parameters.WMI.Buffer**.

Operation

A driver that handles WMI IRPs by calling WMI library support routines calls **WmiSystemControl** with a pointer to its WMILIB_CONTEXT structure, a pointer to its device object, and a pointer to the IRP. **WmiSystemControl** calls the driver's DpWmiExecuteMethod routine, or returns STATUS_INVALID_DEVICE_REQUEST to the caller if the driver does not define an entry point for such a routine

A driver handles an IRP_MN_EXECUTE_METHOD request only if **Parameters.WMI.ProviderId** points to the same device object as the pointer that the driver passed to **IoWMIRegistrationControl**. Otherwise, the driver forwards the request to the next-lower driver

Before handling the request, the driver determines whether **Parameters.WMI.DataPath** points to a GUID supported by the driver. If not, the driver fails the IRP and returns STATUS_WMI_GUID_NOT_FOUND

If the driver supports the data block, it checks the input WNODE_METHOD_ITEM at **Parameters.WMI.Buffer** for the instance name, as follows

- If WNODE_FLAG_STATIC_INSTANCE_NAMES is set in **WnodeHeader.Flags**, the driver uses **InstanceIndex** as an index into the driver's list of static instance names for that block. WMI obtains the index from registration data that was provided by the driver when it registered the block
- If WNODE_FLAG_STATIC_INSTANCE_NAMES is clear in **WnodeHeader.Flags**, the driver uses the offset at **OffsetInstanceName** to locate the instance name string in the input WNODE_METHOD_ITEM. **OffsetInstanceName** is the offset in bytes from the beginning of the structure to a USHORT which is the length of the instance name string in bytes (not characters), including the NUL terminator if present, followed by the instance name string in Unicode

If the driver cannot locate the specified instance, it must fail the IRP and return STATUS_WMI_INSTANCE_NOT_FOUND. In the case of a driver with a dynamic instance name this status indicates that the driver does not "own" the instance. WMI can therefore continue to query other data providers and return an appropriate error to the data consumer if another provider finds the instance but cannot handle the request for some other reason

The driver then checks the method ID in the input WNODE_METHOD_ITEM to determine whether it is a valid method for that data block. If not, the driver fails the IRP and returns STATUS_WMI_ITEM_ID_NOT_FOUND

If the method generates output, the driver should check the size of the output buffer in **Parameters.WMI.BufferSize** before performing any operation that might have side effects or that should not be performed twice. For example, if a method returns the values of a group of counters and then resets the counters, the driver should check the buffer size (and fail the IRP if the buffer is too small) before resetting the counters. This ensures that WMI can safely resend the request with a

larger buffer

If the instance and method ID are valid and the buffer is adequate in size the driver executes the method If **SizeDataBlock** in the input WNODE_METHOD_ITEM is non-zero the driver uses the data starting at **DataBlockOffset** as input for the method

If the method generates output, the driver writes the output data to the buffer starting at **DataBlockOffset** and sets **SizeDataBlock** in the output WNODE_METHOD_ITEM to the number of bytes of output data If the method has no output data, the driver sets **SizeDataBlock** to zero The driver must not change the input value of **DataBlockOffset**

If the instance is valid but the driver cannot handle the request, it can return any appropriate error status

See Also

DpWmiExecuteMethod **IoWMIRegistrationControl** WMILIB CONTEXT, **WmiSystemControl** WNODE_METHOD_ITEM

Built on Tuesday, June 15, 1999

Kernel-Mode Drivers Preliminary Windows 2000 DDK

IRP_MN_QUERY_ALL_DATA

[This is preliminary documentation and subject to change]

All drivers that support WMI must handle this IRP

When Sent

WMI sends this IRP to query for all instances of a given data block

WMI sends this IRP at IRQL PASSIVE_LEVEL in an arbitrary thread context

Input

Parameters.WMI.ProviderId in the driver's I/O stack location in the IRP points to the device object of the driver that should respond to the request

Parameters.WMI.DataPath points to a GUID that identifies the data block.

Parameters.WMI.BufferSize indicates the maximum size of the nonpaged buffer at **Parameters.WMI.Buffer**, which receives output data from the request The buffer size must be greater than or equal to sizeof WNODE_ALL_DATA plus the sizes of instance names and data for all instances to be returned

Output

If the driver handles WMI IRPs by calling **WmiSystemControl** WMI fills in a WNODE_ALL_DATA by calling the driver's DpWmiQueryDataBlock routine once for each block registered by the driver

Otherwise the driver fills in a WNODE_ALL_DATA structure at **Parameters.WMI.Buffer** as follows

- Sets **WnodeHeader.BufferSize** to the number of bytes of the entire WNODE_ALL_DATA to be returned, sets **WnodeHeader.Timestamp** to the value returned by **KeQuerySystemTime** and sets **WnodeHeader.Flags** as appropriate for the data to be returned
- Sets **InstanceCount** to the number of instances to be returned
- If the block uses dynamic instance names sets **OffsetInstanceNameOffsets** to the offset in bytes from the beginning of the WNODE_ALL_DATA to an array of offsets to dynamic instance names
- If all instances are the same size
  - Sets WNODE_FLAG_FIXED_INSTANCE_SIZE in **WnodeHeader.Flags** and sets **FixedInstanceSize** to that size in bytes
  - Writes instance data starting at **DataBlockOffset**, with padding so that each instance is aligned to an 8-byte boundary For example, if **FixedInstanceSize** is 6 the driver adds 2 bytes of padding between instances
- If instances vary in size
  - Clears WNODE_FLAG_FIXED_INSTANCE_SIZE in **WnodeHeader.Flags** and writes an array of **InstanceCount** OFFSETINSTANCEDATAANDLENGTH structures starting at **OffsetInstanceDataAndLength** Each OFFSETINSTANCEDATAANDLENGTH structure specifies the offset in bytes from the beginning of the WNODE_ALL_DATA structure to the beginning of the data for each instance and the length of the data **DataBlockOffset** is not used
  - Writes instance data following the last element of the **OffsetInstanceDataAndLength** array, plus padding so that each instance is aligned to an 8-byte boundary
- If the block uses dynamic instance names, writes the instance names at the offsets specified in the array at **OffsetInstanceNameOffsets** with each dynamic name string aligned to a USHORT boundary

If the buffer at **Parameters.WMI.Buffer** is too small to receive all of the data, a driver fills in the needed size in a WNODE_TOO_SMALL structure at **Parameters.WMI.Buffer** If the buffer is smaller than **sizeof**(WNODE_TOO_SMALL), the driver fails the IRP and returns STATUS_BUFFER_TOO_SMALL

I/O Status Block

If the driver handles the IRP by calling **WmiSystemControl**, WMI sets **Irp->IoStatus.Status** and **Irp->IoStatus.Information** in the I/O status block

Otherwise, the driver sets **Irp->IoStatus.Status** to STATUS_SUCCESS or to an appropriate error status such as the following

STATUS_BUFFER_TOO_SMALL

STATUS_WMI_GUID_NOT_FOUND

On success a driver sets **Irp->IoStatus.Information** to the number of bytes written to the buffer at **Parameters.WMI.Buffer**

Operation

A driver that handles WMI IRPs by calling WMI library support routines calls **WmiSystemControl** with a pointer to its WMILIB_CONTEXT structure, a pointer to its device object, and a pointer to the IRP **WmiSystemControl** calls the driver's DpWmiQueryDataBlock routine

A driver handles an IRP_MN_QUERY_ALL_DATA request only if **Parameters.WMI.ProviderId** points to the same device object that the driver passed to **IoWMIRegistrationControl** Otherwise the driver forwards the request to the next-lower driver

Before handling the request, the driver determines whether **Parameters.WMI.DataPath** points to a GUID that the driver supports If not, the driver fails the IRP and returns STATUS_WMI_GUID_NOT_FOUND

If the driver supports the data block, it fills in a WNODE_ALL_DATA structure at **Parameters.WMI.Buffer** with data for all instances of that data block

See Also

DpWmiQueryDataBlock **IoWMIRegistrationControl**, **KeQuerySystemTime** WMILIB_CONTEXT **WmiSystemControl** WNODE_ALL_DATA

Built on Tuesday, June 15, 1999

Kernel-Mode Drivers Preliminary Windows 2000 DDK

IRP_MN_QUERY_SINGLE_INSTANCE

[This is preliminary documentation and subject to change]

All drivers that support WMI must handle this IRP

When Sent

WMI sends this IRP to query for a single instance of a given data block

WMI will send an IRP_MN_QUERY_SINGLE_INSTANCE prior to sending an IRP_MN_EXECUTE_METHOD If a driver supports IRP_MN_EXECUTE_METHOD it must have a IRP_MN_QUERY_SINGLE_INSTANCE handler for the same data block whose method is being

executed

WMI sends this IRP at IRQL PASSIVE_LEVEL in an arbitrary thread context

Input

Parameters.WMI.ProviderId points to the device object of the driver that should respond to the request This pointer is located in the driver's I/O stack location in the IRP

Parameters.WMI.DataPath points to a GUID that identifies the data block to query

Parameters.WMI.BufferSize indicates the maximum size of the nonpaged buffer at **Parameters.WMI.Buffer**, which points to a WNODE_SINGLE_INSTANCE structure that identifies the instance to query

Output

If the driver handles WMI IRPs by calling **WmiSystemControl**, WMI fills in a WNODE_SINGLE_INSTANCE structure with data provided by the driver's DpWmiQueryDataBlock routine

Otherwise, the driver fills in the WNODE_SINGLE_INSTANCE structure at **Parameters.WMI.Buffer** as follows

- Updates **WnodeHeader.BufferSize** with the size in bytes of the output WNODE_SINGLE_INSTANCE, including instance data
- Sets **SizeDataBlock** to the size in bytes of the instance data
- Writes the instance data to **Parameters.WMI.Buffer** starting at **DataBlockOffset** The driver must not change the input value of **DataBlockOffset**

If the buffer at **Parameters.WMI.Buffer** is too small to receive all of the data, the driver fills in the needed size in a WNODE_TOO_SMALL structure at **Parameters.WMI.Buffer** If the buffer is smaller than **sizeof**(WNODE_TOO_SMALL), the driver fails the IRP and returns STATUS_BUFFER_TOO_SMALL

I/O Status Block

If the driver handles the IRP by calling **WmiSystemControl**, WMI sets **Irp->IoStatus.Status** and **Irp->IoStatus.Information** in the I/O status block

Otherwise, the driver sets **Irp->IoStatus.Status** to STATUS_SUCCESS or to an appropriate error status such as the following

STATUS_BUFFER_TOO_SMALL

STATUS_WMI_GUID_NOT_FOUND

STATUS_WMI_INSTANCE_NOT_FOUND

On success a driver sets **Irp->IoStatus.Information** to the number of bytes written to the buffer at **Parameters.WMI.Buffer**

Operation

A driver that handles WMI IRPs by calling WMI library support routines calls **WmiSystemControl** with a pointer to its WMILIB_CONTEXT structure a pointer to its device object and a pointer to the IRP **WmiSystemControl** calls the driver's DpWmiQueryDataBlock routine

A driver handles an IRP_MN_QUERY_SINGLE_INSTANCE request only if **Parameters.WMI.ProviderId** points to the same device object as the pointer that the driver passed in its call to **IoWMIRegistrationControl** Otherwise, the driver forwards the request to the next-lower driver

Before handling the request the driver determines whether **Parameters.WMI.DataPath** points to a GUID that the driver supports If not the driver fails the IRP and returns STATUS_WMI_GUID_NOT_FOUND

If the driver supports the data block it checks the input WNODE_SINGLE_INSTANCE at **Parameters.WMI.Buffer** for the instance name, as follows

- If WNODE_FLAG_STATIC_INSTANCE_NAMES is set in **WnodeHeader.Flags**, the driver uses **InstanceIndex** as an index into the driver's list of static instance names for that block WMI obtains the index from registration data provided by the driver when it registered the block
- If WNODE_FLAG_STATIC_INSTANCE_NAMES is clear in **WnodeHeader.Flags,** the driver uses the offset at **OffsetInstanceName** to locate the instance name string in the input WNODE_SINGLE_INSTANCE **OffsetInstanceName** is the offset in bytes from the beginning of the structure to a USHORT which is the length of the instance name string in bytes (not characters) including the NULL terminator if present followed by the instance name string in Unicode

If the driver cannot locate the specified instance, it must fail the IRP and return STATUS_WMI_INSTANCE_NOT_FOUND In the case of an instance with a dynamic instance name, this status indicates that the driver does not "own" the instance WMI can therefore continue to query other data providers and return an appropriate error to the data consumer if another provider finds the instance but cannot handle the request for some other reason

If the driver locates the instance and can handle the request, it fills in the WNODE_SINGLE_INSTANCE structure at **Parameters.WMI.Buffer** with data for the instance

If the instance is valid but the driver cannot handle the request, it can return any appropriate error status

See Also

DpWmiQueryDataBlock **IoWMIRegistrationControl**, WMILIB_CONTEXT, **WmiSystemControl** WNODE_SINGLE_INSTANCE

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IRP_MN_REGINFO

[This is preliminary documentation and subject to change]

All drivers that support WMI must handle this IRP

When Sent

WMI sends this IRP to query or update a driver's registration information after the driver has called **IoWMIRegistrationControl**

WMI sends this IRP at IRQL PASSIVE_LEVEL in the context of a system thread

Input

Parameters.WMI.ProviderId points to the device object of the driver that should respond to the request This pointer is located in the driver's I/O stack location in the IRP

Parameters.WMI.DataPath is set to WMIREGISTER to query registration information or WMIUPDATE to update it

Parameters.WMI.BufferSize indicates the maximum size of the nonpaged buffer at **Parameters.WMI.Buffer**. The size must be greater than or equal to the total of (**sizeof**(WMIREGINFO) + (*GuidCount* * **sizeof**(WMIREGGUID)), where *GuidCount* is the number of data blocks and event blocks being registered by the driver, plus space for static instance names, if any

Output

If the driver handles WMI IRPs by calling **WmiSystemControl**, WMI gets registration information for a driver's data blocks by calling its DpWmiQueryReginfo routine

Otherwise, the driver fills in a WMIREGINFO structure at **Parameters.WMI.Buffer** as follows

- Sets **BufferSize** to the size in bytes of the WMIREGINFO structure plus associated registration data
- If the driver handles WMI requests on behalf of another driver, sets **NextWmiRegInfo** to the offset in bytes from the beginning of this WMIREGINFO to the beginning of another WMIREGINFO structure that contains registration information from the other driver
- Sets **RegistryPath** to the registry path that was passed to the driver's **DriverEntry** routine
- If **Parameters.WMI.Datapath** is set to WMIREGISTER, sets **MofResourceName** to the offset from the beginning of this WMIREGINFO to a counted Unicode string that contains the name of the driver's MOF resource in its image file

- Sets **GuidCount** to the number of data blocks and event blocks to register or update
- Writes an array of WMIREGGUID structures, one for each data block or event block exposed by the driver at **WmiRegGuid**

The driver fills in each WMIREGGUID structure as follows

- Sets **Guid** to the GUID that identifies the block
- Sets **Flags** to provide information about instance names and other characteristics of the block. For example, if a block is being registered with static instance names, the driver sets **Flags** with the appropriate WMIREG_FLAG_INSTANCE_*XXX* flag

If the block is being registered with static instance names, the driver

- Sets **InstanceCount** to the number of instances
- Sets one of the following members to an offset in bytes to static instance name data for the block
  - If the driver sets **Flags** with WMIREG_FLAG_INSTANCE_LIST it sets **InstanceNameList** to an offset to a list of static instance name strings WMI specifies instances in subsequent requests by index into this list
  - If the driver sets **Flags** with WMIREG_FLAG_INSTANCE_BASENAME it sets **BaseNameOffset** to an offset to a base name string WMI uses this string to generate static instance names for the block
  - If the driver sets **Flags** with WMIREG_FLAG_INSTANCE_PDO, it sets **Pdo** to an offset to a pointer to the PDO passed to the driver's AddDevice routine WMI uses the device instance path of the PDO to generate static instance names for the block
- Writes the instance name strings, the base name string, or a pointer to the PDO at the offset indicated by **InstanceNameList**, **BaseName**, or **PDO**, respectively

If the driver handles WMI registration on behalf of another driver (such as a miniclass or miniport driver) it fills in another WMIREGINFO structure with the other driver's registration information and writes it at **NextWmiRegInfo** in the previous structure.

If the buffer at **Parameters.WMI.Buffer** is too small to receive all of the data a driver writes the needed size in bytes as a ULONG to **Parameters.WMI.Buffer** and fails the IRP and returns STATUS_BUFFER_TOO_SMALL

I/O Status Block

If the driver handles the IRP by calling **WmiSystemControl** WMI sets **Irp->IoStatus.Status** and **Irp->IoStatus.Information** in the I/O status block

Otherwise, the driver sets **Irp->IoStatus.Status** to STATUS_SUCCESS or to an appropriate error status such as the following

STATUS_BUFFER_TOO_SMALL

On success a driver sets **Irp->IoStatus.Information** to the number of bytes written to the buffer at **Parameters.WMI.Buffer**

Operation

A driver that handles WMI IRPs by calling WMI library support routines calls **WmiSystemControl** with a pointer to its WMILIB_CONTEXT structure, a pointer to its device object and a pointer to the IRP **WmiSystemControl** calls the driver's DpWmiQueryReginfo routine

A driver handles an IRP_MN_REGINFO request only if **Parameters.WMI.ProviderId** points to the same device object as the pointer that the driver passed to **IoWMIRegistrationControl** Otherwise, the driver forwards the request to the next-lower driver

Before handling the request, the driver checks **Parameters.WMI.DataPath** to determine whether WMI is querying registration information (WMIREGISTER) or requesting an update (WMIUPDATE)

WMI sends this IRP with WMIREGISTER after a driver calls **IoWMIRegistrationControl** with WMIREG_ACTION_REGISTER or WMIREG_ACTION_REREGISTER In response, a driver should fill in the buffer at **Parameters.WMI.Buffer** with the following

- A WMIREGINFO structure that indicates the driver's registry path, the name of its MOF resource, and the number of blocks to register
- One WMIREGGUID structure for each block to register If a block is to be registered with static instance names, the driver sets the appropriate WMIREG_FLAG_INSTANCE_*XXX* flag in the WMIREGGUID structure for that block
- Any strings WMI needs to generate static instance names

WMI sends this IRP with WMIUPDATE after a driver calls **IoWmiRegistrationControl** with WMIREG_ACTION_UPDATE_GUID In response, a driver should fill in the buffer at **Parameters.WMI.Buffer** with a WMIREGINFO structure as follows

- To remove a block, the driver sets WMIREG_FLAG_REMOVE_GUID in its WMIREGGUID structure.
- To add or update a block (for example, to change its static instance names) the driver clears WMIREG_FLAG_REMOVE_GUID and provides new or updated registration values for the block
- To register a new or existing block with static instance names the driver sets the appropriate WMIREG_FLAG_INSTANCE_*XXX* and supplies any strings WMI needs to generate static instance names

A driver can use the same WMIREGINFO structures to remove add, or update blocks as it used initially to register all of its blocks, changing only the flags and data for the blocks to be updated If a WMIREGGUID in such a WMIREGINFO structure matches exactly the WMIREGGUID passed by the driver when it first registered that block WMI skips the processing involved in updating the block

WMI does not send an IRP_MN_REGINFO request after a driver calls **IoWMIRegistrationControl** with WMIREG_ACTION_DEREGISTER because WMI requires no further information from the driver A driver typically deregisters its blocks in response to an IRP_MN_REMOVE_DEVICE request

See Also

DpWmiQueryRegInfo **IoWMIRegistrationControl** WMILIB_CONTEXT WMIREGGUID WMIREGINFO **WmiSystemControl**

Built on Tuesday June 15, 1999

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Chapter 2 WMI Library Support Routines

[This is preliminary documentation and subject to change.]

This chapter describes the WMI library support routines that a driver can call to handle WMI IRPs. For information about handling WMI IRPs, see the *Kernel-mode Drivers Design Guide*.

For information about WMI library callback routines, see Chapter 3.

Built on Tuesday June 15, 1999

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WmiCompleteRequest

[This is preliminary documentation and subject to change.]

NTSTATUS
  WmiCompleteRequest(
    IN PDEVICE_OBJECT *DeviceObject*,
    IN PIRP *Irp*,
    IN NTSTATUS *Status*,
    IN ULONG *BufferUsed*,
    IN CCHAR *PriorityBoost*
    );

WmiCompleteRequest indicates that a driver has finished processing a WMI request in a DpWmi*Xxx* routine.

Parameters

DeviceObject
  Points to the driver's device object.
Irp
  Points to the IRP.
Status

  Specifies the status to return for the IRP.
BufferUsed
  Specifies the number of bytes needed in the buffer passed to the driver's DpWmiXxx routine. If the buffer is too small, the driver sets *Status* to STATUS_BUFFER_TOO_SMALL and sets *BufferUsed* to the number of bytes needed for the data to be returned. If the buffer passed is large enough, the driver sets *BufferUsed* to the number of bytes actually used.
PriorityBoost
  Specifies a system-defined constant by which to increment the runtime priority of the original thread that requested the operation. WMI calls **IoCompleteRequest** with *PriorityBoost* when it completes the IRP.

Return Value

WmiCompleteRequest returns the value that was passed to it in the *Status* parameter unless *Status* was set to STATUS_BUFFER_TOO_SMALL. If the driver set *Status* equal to STATUS_BUFFER_TOO_SMALL, **WmiCompleteRequest** builds a WNODE_TOO_SMALL structure and returns STATUS_SUCCESS. The return value from **WmiCompleteRequest** should be returned by the driver in its DpWmi*Xxx* routine.

Comments

A driver calls **WmiCompleteRequest** from a DpWmiXxx routine after it finishes all other processing in that routine, or after the driver finishes all processing for a pending IRP. **WmiCompleteRequest** fills in a WNODE_XXX with any data returned by the driver and calls **IoCompleteRequest** to complete the IRP.

A driver should always return the return value from **WmiCompleteRequest** in its DpWmi*Xxx* routine.

A driver must not call **WmiCompleteRequest** from its DpWmiQueryRegInfo routine.

Callers of **WmiCompleteRequest** must be running at IRQL <= DISPATCH_LEVEL.

See Also

DpWmiExecuteMethod, DpWmiFunctionControl, DpWmiQueryDataBlock, DpWmiQueryRegInfo, DpWmiSetDataBlock, DpWmiSetDataItem, **IoCompleteRequest**, **WmiSystemControl**

Built on Tuesday, June 15, 1999

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WmiFireEvent

[This is preliminary documentation and subject to change.]

NTSTATUS
  WmiFireEvent(

```
IN PDEVICE_OBJECT DeviceObject,
IN LPGUID Guid,
IN ULONG InstanceIndex,
IN ULONG EventDataSize,
IN PVOID EventData
);
```

WmiFireEvent sends an event to WMI for delivery to data consumers that have requested notification of the event

Parameters

DeviceObject
Points to the driver's device object

Guid
Points to the GUID that represents the event block

InstanceIndex
If the event block has multiple instances, specifies the index of the instance

EventDataSize
Specifies the number of bytes of data at *EventData* If no data is generated for an event *EventData* must be zero

EventData
Points to a driver-allocated nonpaged buffer containing data generated by the driver for the event If no data is generated for an event, *EventData* must be NULL WMI frees the buffer without further intervention by the driver

Return Value

WmiFireEvent propagates the status returned by **IoWmiWriteEvent** or returns STATUS_INSUFFICIENT_RESOURCES if it could not allocate memory for the event

Comments

A driver calls **WmiFireEvent** to send an event to WMI for delivery to all data consumers that have requested notification of the event All parameters passed to **WmiFireEvent** must be allocated from nonpaged pool

The driver sends an event only if it has been previously enabled by the driver's DpWmiFunctionControl routine, which WMI calls to process an IRP_MN_ENABLE_EVENT request

The driver writes any data associated with the event to the buffer at *EventData* WMI fills in a WNODE_SINGLE_INSTANCE structure with the data and calls **IoWmiWriteEvent** to deliver the event

Callers of **WmiFireEvent** must be running at IRQL <= DISPATCH_LEVEL

See Also

DpWmiFunctionControl, IRP_MN_ENABLE_EVENTS, **WmiSystemControl**

Built on Tuesday, June 15, 1999

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WmiSystemControl

[This is preliminary documentation and subject to change]

```
NTSTATUS
  WmiSystemControl(
    IN PWMILIB_CONTEXT WmiLibInfo,
    IN PDEVICE_OBJECT DeviceObject,
    IN PIRP Irp,
    OUT PSYSCTL_IRP_DISPOSITION IrpDisposition
    );
```

WmiSystemControl is a dispatch routine for drivers that use WMI library support routines to handle WMI IRPs

Parameters

WmiLibInfo
Points to a WMILIB_CONTEXT structure that contains registration information for a driver's data blocks and event blocks and defines entry points for the driver's WMI library callback routines

DeviceObject
Points to the driver's device object

Irp
Points to the IRP

IrpDisposition
After **WmiSystemControl** returns *IrpDisposition* indicates how the IRP was handled

IrpProcessed
The IRP was processed and possibly completed If the driver's DpWmiXxx routine called by **WMISystemControl** did not complete the IRP, the driver must call **WmiCompleteRequest** to complete the IRP after **WmiSystemControl** returns

IrpNotCompleted
The IRP was processed but not completed, either because WMI detected an error and set up the IRP with an appropriate error code or processed an IRP_MN_REGINFO request The driver must complete the IRP by calling **IoCompleteRequest**

IrpNotWmi
The IRP is not a WMI request (that is, WMI does not recognize the IRP's minor code) If the driver handles IRP_MJ_SYSTEM_CONTROL requests with this IRP_MN_XXX it should handle the IRP otherwise the driver should forward the IRP to the next lower driver

IrpForward

The IRP is targeted to another device object (that is the device object pointer at **Parameters.WMI.ProviderId** in the IRP does not match the pointer passed by the driver in its call to **IoWMIRegistrationControl**) The driver must forward the IRP to the next lower driver

Return Value

WmiSystemControl returns STATUS_SUCCESS or one of the following error codes

STATUS_INVALID_DEVICE_REQUEST

STATUS_WMI_GUID_NOT_FOUND

STATUS_WMI_INSTANCE_NOT_FOUND

Comments

When a driver receives an IRP_MJ_SYSTEM_CONTROL request with a WMI IRP minor code it calls **WmiSystemControl** with a pointer to the driver's WMILIB CONTEXT structure a pointer to its device object and a pointer to the IRP The WMILIB_CONTEXT structure contains registration information for the driver's data blocks and event blocks and defines entry points for its WMI library callback routines

WmiSystemControl confirms that the IRP is a WMI request and determines whether the block specified by the request is valid for the driver If so, it processes the IRP by calling the appropriate DpWmiXxx entry point in the driver's WMILIB_CONTEXT structure WMI is running at IRQL PASSIVE_LEVEL when it calls the driver's DpWmiXxx routine

Callers of **WmiSystemControl** must be running at IRQL PASSIVE_LEVEL

A driver must be running at IRQL PASSIVE_LEVEL when it forwards an IRP_MJ SYSTEM_CONTROL request to the next-lower driver

See Also

DpWmiExecuteMethod, DpWmiFunctionControl, DpWmiQueryDataBlock, DpWmiQueryRegInfo, DpWmiSetDataBlock DpWmiSetDataItem, WMILIB_CONTEXT

Built on Tuesday, June 15, 1999

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Chapter 3 WMI Library Callback Routines

[This is preliminary documentation and subject to change]

This describes required and optional routines that a driver must implement to handle WMI IRPs by calling WMI library support routines A driver sets entry points to its DpWmiXxx routines in the

WMILIB_CONTEXT structure the driver passes to **WmiSystemControl**

A driver's DpWmi*Xxx* routines can have any names chosen by the driver writer

For information about WMI library support routines see Chapter 2 For information about handling WMI IRPs, see the *Kernel-mode Drivers Design Guide*

Built on Tuesday June 15, 1999

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DpWmiExecuteMethod

[This is preliminary documentation and subject to change]

```
NTSTATUS
  DpWmiExecuteMethod(
    IN PDEVICE_OBJECT DeviceObject,
    IN PIRP Irp,
    IN ULONG GuidIndex,
    IN ULONG InstanceIndex,
    IN ULONG MethodId,
    IN ULONG InBufferSize,
    IN ULONG OutBufferSize,
    IN OUT PUCHAR Buffer
    );
```

A driver's DpWmiExecuteMethod routine executes a method associated with a data block This routine is optional

Parameters

DeviceObject
: Points to the driver's device object

Irp
: Points to the IRP

GuidIndex
: Specifies the data block by its index into the list of GUIDs provided by the driver in the WMILIB_CONTEXT structure it passed to **WmiSystemControl**

InstanceIndex
: If the block specified by *GuidIndex* has multiple instances, *InstanceIndex* specifies the instance

MethodId
: Specifies the ID of the method to execute The driver defines the method ID as an item in a data block

InBufferSize
: Indicates the size in bytes of the input data If there is no input data, *InBufferSize* is zero

OutBufferSize

Indicates the number of bytes available in the buffer for output data

Buffer

Points to a buffer that holds the input data and receives the output data, if any from the method If the buffer is too small to receive all of the output, the driver returns STATUS_BUFFER_TOO_SMALL and calls **WmiCompleteRequest** with the size required

Return Value

DpWmiExecuteMethod returns STATUS_SUCCESS or an appropriate error code such as the following

STATUS_BUFFER_TOO_SMALL

STATUS_INVALID_DEVICE_REQUEST

STATUS_WMI_INSTANCE_NOT_FOUND

STATUS_WMI_ITEM_ID_NOT_FOUND

Comments

WMI calls a driver's DpWmiExecuteMethod routine after the driver calls **WmiSystemControl** in response to an IRP_MN_EXECUTE_METHOD request

If a driver does not implement a DpWmiExecuteMethod routine, it must set **ExecuteWmiMethod** to NULL in the WMILIB_CONTEXT the driver passes to **WmiSystemControl** In this case WMI returns STATUS_INVALID_DEVICE_REQUEST to the caller in response to any IRP_MN_EXECUTE_METHOD request

If the method generates output, the driver should check the size of the output buffer in *OutBufferSize* before performing any operation that might have side effects or that should not be performed twice For example, if a method returns the values of a group of counters and then resets the counters, the driver should check the buffer size (and possibly return STATUS_BUFFER_TOO_SMALL) before resetting the counters This ensures that WMI can safely re-send the request with a larger buffer

After executing the method and writing output, if any, to the buffer, the driver calls **WmiCompleteRequest** to complete the request

This routine can be pageable

See Also

IRP_MN_EXECUTE_METHOD WMILIB_CONTEXT **WmiCompleteRequest** **WmiSystemControl**

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DpWmiFunctionControl

[This is preliminary documentation and subject to change]

NTSTATUS
DpWmiFunctionControl(
IN PDEVICE_OBJECT *DeviceObject*,
IN PIRP *Irp*,
IN ULONG *GuidIndex*,
IN WMIENABLEDISABLECONTROL *Function*,
IN BOOLEAN *Enable*
);

A driver's DpWmiFunctionControl routine enables or disables notification of events It also enables or disables data collection for data blocks that the driver registered as expensive to collect This routine is optional

Parameters

DeviceObject

Points to the driver's device object

Irp

Points to the IRP

GuidIndex

Specifies the block by its index into the list of GUIDs provided by the driver in the WMILIB_CONTEXT structure it passed to **WmiSystemControl**

Function

Specifies WmiEventControl to enable or disable an event or WmiDataBlockControl to enable or disable data collection for a block that was registered as expensive to collect (that is, a block for which the driver set WMIREG_FLAG_EXPENSIVE in **Flags** of the WMIGUIDREGINFO structure used to register the block)

Enable

Specifies TRUE to enable the event or data collection or FALSE to disable it

Return Value

DpWmiFunctionControl returns STATUS_SUCCESS or an appropriate error status such as

STATUS_WMI_GUID_NOT_FOUND

STATUS_INVALID_DEVICE_REQUEST

Comments

WMI calls a driver's DpWmiFunctionControl routine after the driver calls **WmiSystemControl** in response to one of the following requests

IRP_MN_ENABLE_COLLECTION

IRP_MN_DISABLE_COLLECTION

IRP_MN_ENABLE_EVENTS

IRP_MN_DISABLE_EVENTS

If a driver does not implement a DpWmiFunctionControl routine, it must set **WmiFunctionControl** to NULL in the WMILIB_CONTEXT the driver passes to **WmiSystemControl** WMI returns STATUS_SUCCESS to the caller

It is unnecessary for the driver to check whether events or data collection are already enabled for a block because WMI sends a single enable request when the first data consumer enables the block and sends a single disable request when the last data consumer disables the block WMI will not call DpWmiFunctionControl to enable a block without an intervening call to disable it

After enabling or disabling the event or data collection for the block the driver calls **WmiCompleteRequest** to complete the request

This routine can be pageable

See Also

IRP_MN_ENABLE_COLLECTION, IRP_MN_DISABLE_COLLECTION, IRP_MN_ENABLE_EVENTS, IRP_MN_DISABLE_EVENTS, WMILIB_CONTEXT, **WmiSystemControl**

Built on Tuesday June 15, 1999

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DpWmiQueryDataBlock

[This is preliminary documentation and subject to change]

NTSTATUS
DpWmiQueryDataBlock(
IN PDEVICE_OBJECT *DeviceObject*,
IN PIRP *Irp*,
IN ULONG *GuidIndex*,
IN ULONG *InstanceIndex*,
IN ULONG *InstanceCount*,
IN OUT PULONG *InstanceLengthArray*,
IN ULONG *BufferAvail*,
OUT PUCHAR *Buffer*

);

A driver's DpWmiQueryDataBlock routine returns either a single instance or all instances of a data block This routine is required

Parameters

DeviceObject
Points to the driver's device object

Irp
Points to the IRP

GuidIndex
Specifies the data block by its index into the list of GUIDs provided by the driver in the WMILIB_CONTEXT structure it passed to **WmiSystemControl**

InstanceIndex
If DpWmiQueryDataBlock is called in response to an IRP_MN_QUERY_SINGLE_INSTANCE request *InstanceIndex* specifies the instance to be queried If DpWmiQueryDataBlock is called in response to an IRP_MN_QUERY_ALL_DATA REQUEST *InstanceIndex* is zero

InstanceCount
If DpWmiQueryDataBlock is called in response to an IRP_MN_QUERY_SINGLE_INSTANCE request *InstanceCount* is 1 If DpWmiQueryDataBlock is called in response to an IRP_MN_QUERY_ALL_DATA REQUEST, *InstanceCount* is the number of instances to be returned

InstanceLengthArray
Points to an array of ULONGs that indicate the length of each instance to be returned If the buffer at *Buffer* is too small to receive all of the data, the driver sets *InstanceLengthArray* to NULL

BufferAvail
Specifies the maximum number of bytes available to receive data in the buffer at *Buffer*

Buffer
Points to the buffer to receive instance data If the buffer is large enough to receive all of the data, the driver writes instance data to the buffer with each instance aligned on an 8-byte boundary If the buffer is too small to receive all of the data, the driver calls **WmiCompleteRequest** with *BufferUsed* set to the size required

Return Value

DpWmiQueryDataBlock returns STATUS_SUCCESS or an error status such as the following

STATUS_BUFFER_TOO_SMALL

STATUS_WMI_GUID_NOT_FOUND

STATUS_WMI_INSTANCE_NOT_FOUND

If the driver cannot complete the request immediately, it can return STATUS_PENDING

Comments

WMI calls a driver's DpWmiQueryDataBlock routine after the driver calls **WmiSystemControl** in response to an IRP_MN_QUERY_DATA_BLOCK or IRP_MN_QUERY_ALL_DATA request.

After writing instance data to the buffer, the driver calls **WmiCompleteRequest** to complete the request

This routine can be pageable

See Also

IRP_MN_QUERY_ALL_DATA, IRP_MN_QUERY_SINGLE_INSTANCE, WMILIB_CONTEXT, **WmiCompleteRequest**, **WmiSystemControl**

Built on Tuesday, June 15, 1999

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DpWmiQueryReginfo

[This is preliminary documentation and subject to change.]

NTSTATUS
DpWmiQueryReginfo(
IN PDEVICE_OBJECT *DeviceObject*,
OUT PULONG *RegFlags*,
OUT PUNICODE_STRING *InstanceName*,
OUT PUNICODE_STRING **RegistryPath*,
OUT PUNICODE_STRING *MofResourceName*,
OUT PDEVICE_OBJECT **Pdo*
);

A driver's DpWmiQueryReginfo routine provides information about the data blocks and event blocks to be registered by a driver This routine is required

Parameters

DeviceObject
Points to the driver's device object

RegFlags
Indicates common characteristics of all blocks being registered Any flag set in *RegFlags* is applied to all blocks A driver can supplement *RegFlags* for a given block by setting **Flags** in the block's WMIGUIDREGINFO structure For example a driver might clear WMIREG_FLAG_EXPENSIVE in *RegFlags* but set it in **Flags** to register a given block as expensive to collect

The driver sets one of the following flags in *RegFlags*

WMIREG_FLAG_INSTANCE_BASENAME

Requests WMI to generate static instance names from a base name provided by the driver at the *InstanceName* WMI generates instance names by appending a counter to the base name

WMIREG_FLAG_INSTANCE_PDO
Requests WMI to generate static instance names from the device instance ID for the PDO If the driver sets this flag, it must also set *Pdo* to the PDO passed to the driver's AddDevice routine WMI generates instance names from the device instance path of the PDO. Using the device instance path as a base for static instance names is efficient because such names are guaranteed to be unique WMI automatically supplies a "friendly" name for the instance as an item in a data block that can be queried by data consumers

A driver might also set one or more of the following flags in *RegFlags*, but more typically would set them in **Flags** of a block's WMIGUIDREGINFO structure

WMIREG_FLAG_EVENT_ONLY_GUID
The blocks can be enabled or disabled as events only, and cannot be queried or set If this flag is clear, the blocks can also be queried or set

WMIREG_FLAG_EXPENSIVE
Requests WMI to send an IRP_MN_ENABLE_COLLECTION request the first time a data consumer opens a data block and an IRP_MN_DISABLE_COLLECTION request when the last data consumer closes the data block This is recommended if collecting such data affects performance, because a driver need not collect the data until a data consumer explicitly requests it by opening the block

WMIREG_FLAG_REMOVE_GUID
Requests WMI to remove support for the blocks This flag is valid only in response to a request to update registration information (IRP_MN_REGINFO with **DataPath** set to WMIUPDATE)

InstanceName
Points to a single counted Unicode string that serves as the base name for all instances of all blocks to be registered by the driver WMI frees the string with **ExFreePool** If WMIREG_FLAG_INSTANCE_BASENAME is clear, *InstanceName* is ignored

RegistryPath
Points to a counted Unicode string that specifies the registry path passed to the driver's **DriverEntry** routine

MofResourceName
Points to a single counted Unicode string that indicates the name of the MOF resource attached to the driver's binary image file This string can be a static string or one that the driver allocates If the driver allocates the string, the driver is responsible for freeing the string If the driver does not have a MOF resource attached, it can leave *MofResourceName* unchanged

Pdo
Points to the physical device object (PDO) passed to the driver's AddDevice routine If WMIREG_FLAG_INSTANCE_PDO is set WMI uses the device instance path of this PDO as a base from which to generate static instance names If WMIREG_FLAG_INSTANCE_PDO is clear, WMI ignores *Pdo*

Return Value

DpWmiQueryReginfo always returns STATUS_SUCCESS

Comments

WMI calls a driver's DpWmiQueryReginfo after the driver calls **WmiSystemControl** in response to an IRP_MN_REGINFO request. WMI sends this IRP after a driver calls **IoWMIRegistrationControl** with WMIREG_ACTION_REGISTER, WMIREG_ACTION_REREGISTER, or WMIREG_ACTION_UPDATE.

WMI does not send an IRP_MN_REGINFO request after a driver calls **IoWMIRegistrationControl** with WMIREG_ACTION_DEREGISTER, because WMI requires no further information from the driver. A driver typically deregisters its blocks in response to an IRP_MN_REMOVE_DEVICE request.

The driver provides new or updated registration information about individual blocks, or indicates blocks to remove, in the WMILIB_CONTEXT structure it passes to **WmiSystemControl**. After the initial call, which establishes the driver's registry path and MOF resource name, a driver's DpWmiQueryReginfo routine can change flags common to all of a driver's blocks, provide a different base name string used to generate instance names, or change the basis for instance names from a string to the device instance path of the PDO.

The driver must not return STATUS_PENDING or block the request. The driver must not complete the request by calling **WmiCompleteRequest** from its DpWmiQueryReginfo routine or by calling **IoCompleteRequest** after **WmiSystemControl** returns.

This routine can be pageable.

See Also

IoWMIRegistrationControl, IRP_MN_REGINFO, WMILIB_CONTEXT, WMIGUIDREGINFO, **WmiSystemControl**

Built on Tuesday, June 15, 1999

Kernel-Mode Drivers: Preliminary Windows 2000 DDK

DpWmiSetDataBlock

[This is preliminary documentation and subject to change.]

NTSTATUS
DpWmiSetDataBlock(
IN PDEVICE_OBJECT *DeviceObject*,
IN PIRP *Irp*,
IN ULONG *GuidIndex*,
IN ULONG *InstanceIndex*,
IN ULONG *BufferSize*,
IN PUCHAR *Buffer*
);

A driver's DpWmiSetDataBlock routine changes all data items in a single instance of a data block. This routine is optional.

Parameters

DeviceObject
Points to the driver's device object.
Irp
Points to the IRP.
GuidIndex
Specifies the data block by its index into the list of GUIDs provided by the driver in the WMILIB_CONTEXT structure it passed to **WmiSystemControl**.
InstanceIndex
If the block specified by *GuidIndex* has multiple instances, *InstanceIndex* specifies the instance.
BufferSize
Specifies the size in bytes of the buffer at *Buffer*.
Buffer
Points to a buffer that contains new values for the instance.

Return Value

DpWmiSetDataBlock returns STATUS_SUCCESS or an appropriate error status such as the following:

STATUS_WMI_INSTANCE_NOT_FOUND

STATUS_WMI_GUID_NOT_FOUND

STATUS_WMI_READ_ONLY

STATUS_WMI_SET_FAILURE

If the driver cannot complete the request immediately, it can return STATUS_PENDING.

Comments

WMI calls a driver's DpWmiSetDataItem routine after the driver calls **WmiSystemControl** in response to an IRP_MN_CHANGE_SINGLE_INSTANCE request.

If a driver does not implement a DpWmiSetDataItem routine, it must set **SetWmiDataBlock** to NULL in the WMILIB_CONTEXT the driver passes to **WmiSystemControl**. WMI returns STATUS_READ_ONLY to the caller.

This routine can be pageable.

See Also

IRP_MN_CHANGE_SINGLE_INSTANCE, WMILIB_CONTEXT, **WmiSystemControl**

Built on Tuesday June 15, 1999

Kernel-Mode Drivers Preliminary Windows 2000 DDK

DpWmiSetDataItem

[This is preliminary documentation and subject to change]

NTSTATUS
DpWmiSetDataItem(
IN PDEVICE_OBJECT *DeviceObject*,
IN PIRP *Irp*,
IN ULONG *GuidIndex*,
IN ULONG *InstanceIndex*,
IN ULONG *DataItemId*,
IN ULONG *BufferSize*,
IN PUCHAR *Buffer*
);

A driver's DpWmiSetDataItem changes a single data item in an instance of a data block This routine is optional

Parameters

DeviceObject
Points to the driver's device object

Irp
Points to the IRP

GuidIndex
Specifies the data block by its index into the list of GUIDs provided by the driver in the WMILIB_CONTEXT structure it passed to **WmiSystemControl**

InstanceIndex
If the block specified by *GuidIndex* has multiple instances, *InstanceIndex* specifies the instance

DataItemId
Specifies the ID of the data item to set

BufferSize
Specifies the size in bytes of the buffer at *Buffer*

Buffer
Points to a buffer that contains the new value for the data item

Return Value

DpWmiSetDataItem returns STATUS SUCCESS or an appropriate error code such as the following

STATUS_WMI_INSTANCE_NOT_FOUND

STATUS_WMI_INSTANCE_ID_NOT_FOUND

STATUS_WMI_GUID_NOT_FOUND

STATUS_WMI_READ_ONLY

STATUS_WMI_SET_FAILURE

Comments

WMI calls a driver's DpWmiSetDataItem routine after the driver calls **WmiSystemControl** in response to an IRP_MN_CHANGE_SINGLE_ITEM request

If a driver does not implement a DpWmiSetDataItem routine it must set **SetWmiDataItem** to NULL in the WMILIB_CONTEXT the driver passes to **WmiSystemControl** WMI returns STATUS_READ_ONLY to the caller

This routine can be pageable

See Also

IRP_MN_CHANGE_SINGLE_ITEM WMILIB_CONTEXT, **WmiSystemControl**

Built on Tuesday, June 15, 1999

Kernel-Mode Drivers Preliminary Windows 2000 DDK

Chapter 4 WMI Structures

[This is preliminary documentation and subject to change

This describes, in alphabetic order, the structures that are used to pass WMI information between WMI and drivers that are kernel-mode data providers

Built on Tuesday, June 15, 1999

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WMILIB_CONTEXT

[This is preliminary documentation and subject to change]

```
typedef struct _WMILIB_CONTEXT {
    ULONG GuidCount,
```

```
    PWMIGUIDREGINFO GuidList,
    PWMI_QUERY_REGINFO QueryWmiRegInfo,
    PWMI_QUERY_DATABLOCK QueryWmiDataBlock,
    PWMI_SET_DATABLOCK SetWmiDataBlock,
    PWMI_SET_DATAITEM SetWmiDataItem,
    PWMI_EXECUTE_METHOD ExecuteWmiMethod,
    PWMI_FUNCTION_CONTROL WmiFunctionControl,
} WMILIB_CONTEXT, *PWMILIB_CONTEXT,
```

A WMILIB_CONTEXT structure provides registration information for a driver's data blocks and event blocks and defines entry points for the driver's WMI library callback routines

Members

GuidCount
: Specifies the number of blocks registered by the driver

GuidList
: Points to an array of **GuidCount** WMIGUIDREGINFO structures that contain registration information for each block

QueryWmiRegInfo
: Points to the driver's DpWmiQueryReginfo routine, which is a required entry point for drivers that call WMI library support routines

QueryWmiDataBlock
: Points to the driver's DpWmiQueryDataBlock routine, which is a required entry point for drivers that call WMI library support routines

SetWmiDataBlock
: Points to the driver's DpWmiSetDataBlock routine which is an optional entry point for drivers that call WMI library support routines If the driver does not implement this routine, it must set this member to NULL In this case, WMI returns STATUS_WMI_READ_ONLY to the caller in response to any IRP_MN_CHANGE_SINGLE_INSTANCE request

SetWmiDataItem
: Points to the driver's DpWmiSetDataItem routine which is an optional entry point for drivers that call WMI library support routines If the driver does not implement this routine it must set this member to NULL In this case, WMI returns STATUS_WMI_READ_ONLY to the caller in response to any IRP_MN_CHANGE_SINGLE_ITEM request.

ExecuteWmiMethod
: Points to the driver's DpWmiExecuteMethod routine, which is an optional entry point for drivers that call WMI library support routines If the driver does not implement this routine, it must set this member to NULL. In this case, WMI returns STATUS_INVALID_DEVICE_REQUEST to the caller in response to any IRP_MN_EXECUTE_METHOD request

WmiFunctionControl
: Points to the driver's DpWmiFunctionControl routine, which is an optional entry point for drivers that call WMI library support routines If the driver does not implement this routine, it must set this member to NULL In this case, WMI returns STATUS_SUCCESS to the caller in response to any IRP_MN_ENABLE_*XXX* or IRP_MN_DISABLE_*XXX* request.

Comments

A driver that handles WMI IRPs by calling WMI library support routines stores an initialized WMILIB_CONTEXT structure (or a pointer to such a structure) in its device extension A driver can

use the same WMILIB_CONTEXT structure for multiple device objects if each device object supplies the same set of data blocks

When the driver receives an IRP_MJ_SYSTEM_CONTROL request it calls **WmiSystemControl** with a pointer to its WMILIB_CONTEXT structure a pointer to its device object, and a pointer to the IRP **WmiSystemControl** determines whether the IRP contains a WMI request and if so handles the request by calling the driver's appropriate DpWmiXxx routine

Memory for this structure can be allocated from paged pool

See Also

DpWmiExecuteMethod DpWmiFunctionControl DpWmiQueryReginfo DpWmiQueryDataBlock DpWmiSetDataBlock, DpWmiSetDataItem, WMIGUIDREGINFO, **WmiSystemControl**

Built on Tuesday June 15 1999

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WMIGUIDREGINFO

[This is preliminary documentation and subject to change]

```
typedef struct {
    LPCGUID Guid,
    ULONG InstanceCount,
    ULONG Flags,
} WMIGUIDREGINFO, *PWMIGUIDREGINFO,
```

A WMIGUIDREGINFO structure contains registration information for a given data block or event block exposed by a driver that uses the WMI library support routines

Members

Guid
: Points to the GUID that identifies the block The memory that contains the GUID can be paged unless it is also used to call **WmiFireEvent**

InstanceCount
: Specifies the number of instances defined for the block

Flags
: Indicates characteristics of the block WMI ORs **Flags** with the flags set by the driver in the *RegFlags* parameter of its DpWmiQueryReginfo routine, which apply to all of the data blocks and event blocks registered by the driver **Flags** therefore supplements the driver's default settings for a given block.

  A driver might set the following flag in **Flags**

  WMIREG_FLAG_INSTANCE_PDO
  : Requests WMI to generate static instance names from the device instance ID for the PDO If this flag is set the *Pdo* parameter of the driver's DpWmiQueryReginfo routine

points to the PDO passed to the driver's AddDevice routine WMI generates instance names from the device instance path of the PDO. Using the device instance path as a base for static instance names is efficient because such names are guaranteed to be unique WMI automatically supplies a "friendly" name for the instance as an item in a data block that can be queried by data consumers

A driver might also set one or more of the following flags

WMIREG_FLAG_EVENT_ONLY_GUID
: The block can be enabled or disabled as an event only, and cannot be queried or set If this flag is clear, the block can also be queried or set

WMIREG_FLAG_EXPENSIVE
: Requests WMI to send an IRP_MN_ENABLE_COLLECTION request the first time a data consumer opens the data block and an IRP_MN_DISABLE_COLLECTION request when the last data consumer closes the data block This is recommended if collecting such data affects performance, because a driver need not collect the data until a data consumer explicitly requests it by opening the block

WMIREG_FLAG_REMOVE_GUID
: Requests WMI to remove support for this block This flag is valid only in response to a request to update registration information (IRP_MN_REGINFO with **DataPath** set to WMIUPDATE)

Comments

A driver that handles WMI IRPs by calling WMI library support routines builds An array of WMIGUIDREGINFO structures, one for each data block and event block to be registered The driver sets the **GuidList** member of its WMILIB_CONTEXT structure to point to the first WMIGUIDREGINFO in the series

Memory for this structure can be allocated from paged pool

See Also

DpWmiQueryReginfo, IRP_MN_DISABLE_COLLECTION, IRP_MN_ENABLE_COLLECTION IRP_MN_REGINFO, **WmiFireEvent**, WMILIB_CONTEXT

Built on Tuesday June 15 1999

Kernel-Mode Drivers Preliminary Windows 2000 DDK

WMIREGGUID

[This is preliminary documentation and subject to change]

```
typedef struct {
    GUID Guid
    ULONG Flags,
    ULONG InstanceCount,
    union {
        ULONG InstanceNameList
```



```
        ULONG BaseNameOffset;
        ULONG_PTR Pdo,
        ULONG_PTR InstanceInfo;
    },
} WMIREGGUID, *PWMIREGGUID
```

A WMIREGGUID contains new or updated registration information for a data block or event block

Members

Guid
: Specifies the GUID that represents the block to register or update

Flags
: Indicates characteristics of the block to register or update

If a block is being registered with static instance names a driver sets one of the following flags

WMIREG_FLAG_INSTANCE_LIST
: Indicates that the driver provides static instance names for this block in a static list following the WMIREGINFO structure in the buffer at **IrpStack->Parameters.WMI.Buffer** If this flag is set, **InstanceNameList** is the offset in bytes from the beginning of the WMIREGINFO structure that contains this WMIREGGUID to a contiguous series of **InstanceCount** counted UNICODE strings

WMIREG_FLAG_INSTANCE_BASENAME
: Requests WMI to generate static instance names from a base name provided by the driver following the WMIREGINFO structure in the buffer at **IrpStack->Parameters.WMI.Buffer** WMI generates instance names by appending a counter to the base name If this flag is set, **BaseNameOffset** is the offset in bytes from the beginning of the WMIREGINFO structure that contains this WMIREGGUID to a single counted UNICODE string that serves as the base name

WMIREG_FLAG_INSTANCE_PDO
: Requests WMI to generate static instance names from the device instance ID for the PDO If this flag is set, **InstanceInfo** points to the PDO passed to the driver's AddDevice routine WMI generates instance names from the device instance path of the PDO Using the device instance path as a base for static instance names is efficient because such names are guaranteed to be unique WMI automatically supplies a "friendly" name for the instance as an item in a data block that can be queried by data consumers

If a block is being registered with dynamic instance names, WMIREG_FLAG_INSTANCE_LIST, WMIREG_FLAG_INSTANCE_BASENAME, and WMIREG_FLAG_INSTANCE_PDO must be clear

A driver might also set one or more of the following flags

WMIREG_FLAG_EVENT_ONLY_GUID
: The block can be enabled or disabled as an event only, and cannot be queried or set If this flag is clear, the block can also be queried or set

WMIREG_FLAG_EXPENSIVE
: Requests WMI to send an IRP_MN_ENABLE_COLLECTION request the first time a data consumer opens the data block and an IRP_MN_DISABLE_COLLECTION request when the last data consumer closes the data block This is recommended if collecting such data affects performance, because a driver need not collect the data until a data

consumer explicitly requests it by opening the block

WMIREG_FLAG_REMOVE_GUID
: Requests WMI to remove support for this block. This flag is valid only in response to a request to update registration information (IRP_MN_REGINFO with **DataPath** set to WMIUPDATE)

WMIREG_FLAG_TRACED_GUID
: The block can be written only to a log file and can be accessed only through user-mode routines declared in *evntrace.h*. Only NT kernel-mode data providers set this flag

WMIREG_FLAG_TRACE_CONTROL_GUID
: The GUID acts as the control GUID for enabling or disabling the trace GUIDs associated with it in the MOF file. This flag is valid only if WMIREG_FLAG_TRACED_GUID is also set. Only NT kernel-mode data providers set this flag

InstanceCount
: Specifies the number of static instance names to be defined for this block. If the block is being registered with dynamic instance names, WMI ignores **InstanceCount**

InstanceNameList
: Indicates the offset in bytes from the beginning of the WMIREGINFO structure that contains this WMIREGGUID to a contiguous series of **InstanceCount** counted Unicode strings. This member is valid only if WMIREG_FLAG_INSTANCE_LIST is set in **Flags**. If the block is being registered with dynamic instance names, WMI ignores **InstanceNameList**

BaseNameOffset
: Indicates the offset in bytes from the beginning of the WMIREGINFO structure that contains this WMIREGGUID to a single counted UNICODE string that serves as a base for WMI to generate static instance names. This member is valid only if WMIREG_FLAG_INSTANCE_BASENAME is set in **Flags**. If the block is being registered with dynamic instance names, WMI ignores **BaseNameOffset**

Pdo
: Points to the physical device object (PDO) passed to the driver's AddDevice routine. WMI uses the device instance path of this PDO as a base from which to generate static instance names. This member is valid only if WMIREG_FLAG_INSTANCE_PDO is set in **Flags**. If the block is being registered with dynamic instance names, WMI ignores **Pdo**

InstanceInfo
: Reserved for use by WMI

Comments

A driver builds one or more WMIREGGUID structures in response to an IRP_MN_REGINFO request to register or update its blocks. The driver passes an array of such structures at the **WmiRegGuid** member of a WMIREGINFO structure, which the driver writes to the buffer at **IrpStack->Parameters.WMI.Buffer**

A driver can register or update a block with either static or dynamic instance names. Static instance names provide best performance, however, dynamic instance names are preferred for data blocks if the number of instances or instance names change frequently. For more information about instance names, see the *Kernel-mode Drivers Design Guide*

See Also

IRP_MN_REGINFO, WMIREGINFO

Built on Tuesday June 15, 1999

Kernel-Mode Drivers Preliminary Windows 2000 DDK

WMIREGINFO

[This is preliminary documentation and subject to change]

```
typedef struct {
    ULONG BufferSize,
    ULONG NextWmiRegInfo,
    ULONG RegistryPath,
    ULONG MofResourceName,
    ULONG GuidCount,
    WMIREGGUIDW WmiRegGuid[],
} WMIREGINFO, *PWMIREGINFO
```

A WMIREGINFO structure contains information provided by a driver to register or update its data blocks and event blocks

Members

BufferSize
: Indicates the total size of the WMI registration data associated with this WMIREGINFO structure calculated as follows (**sizeof**(WMIREGINFO) + (**GuidCount** * **sizeof** (WMIREGGUID) + *additionaldata*) Additional data might include items such as the MOF resource name, registry path and static instance names for blocks

NextWmiRegInfo
: If a driver handles WMI requests on behalf of another driver, as a class driver might on behalf of a miniclass driver, **NextWmiRegInfo** indicates the offset in bytes from the beginning of this WMIREGINFO to the next WMIREGINFO structure that contains WMI registration information for the other driver. Otherwise, **NextWmiRegInfo** is zero

RegistryPath
: Indicates the offset in bytes from the beginning of this structure to a counted Unicode string that specifies the registry path passed to the driver's **DriverEntry** routine. The string must be aligned on a USHORT boundary. This member should be set only in response to a WMI registration request (IRP_MN_REGINFO with **DataPath** set to WMIREGISTER)

MofResourceName
: Indicates the offset in bytes from the beginning of this structure to a counted Unicode string that specifies the name of the MOF resource in the driver's image file. The string must be aligned on a USHORT boundary. This member should be set only in response to a WMI registration request (IRP_MN_REGINFO with **DataPath** set to WMIREGISTER)

GuidCount
: Indicates the number of WMIREGGUID structures in the array at **WmiRegGuid**

WmiRegGuid
: Is an array of **GuidCount** WMIREGGUID structures

Comments

In response to a registration request (IRP_MN_REGINFO with **DataPath** set to WMIREGISTER), a driver builds at least one WMIREGINFO structure and writes the WMIREGINFO structure to the buffer at **IrpStack->Parameters.WMI.Buffer** The WMIREGINFO structure contains an array of WMIREGGUID structures, one for each data block or event block exposed by the driver.

If the driver handles WMI requests on behalf of another driver, it builds another WMIREGINFO containing an array of WMIREGGUID structures for each block exposed by the other driver, sets the **NextWmiRegInfo** member of the first WMIREGINFO to an offset in bytes from the beginning of the first WMIREGINFO to the beginning of the next WMIREGINFO in the buffer, and writes both structures to the buffer The driver indicates the total size of both WMIREGINFO structures and associated data when calls **IoCompleteRequest** to complete the IRP.

A driver can use the same WMIREGINFO structure(s) to remove or update blocks in response to an update request (IRP_MN_REGINFO with **DataPath** set to WMIUPDATE) If WMIREG_FLAG_REMOVE_GUID is set in the **Flags** member of a WMIREGGUID, WMI removes that block from the list of blocks previously registered by the driver If WMIREG_FLAG_REMOVE_GUID is clear, WMI updates registration information for that block only if other WMIREGGUID members have changed—otherwise, WMI does not change to its registration information for that block

See Also

IoCompleteRequest, IRP_MN_REGINFO WMIREGGUID

Built on Tuesday June 15, 1999

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WNODE_ALL_DATA

[This is preliminary documentation and subject to change]

```
typedef struct tagWNODE_ALL_DATA {
    struct _WNODE_HEADER WnodeHeader,
    ULONG DataBlockOffset
    ULONG InstanceCount,
    ULONG OffsetInstanceNameOffsets,
    union {
        ULONG FixedInstanceSize,
        OFFSETINSTANCEDATAANDLENGTH OffsetInstanceDataAndLength[],
    },
} WNODE_ALL_DATA, *PWNODE_ALL_DATA
```

A WNODE_ALL_DATA structure contains data for all instances of a data block or event block

Members

WnodeHeader
Is a WNODE_HEADER structure that contains information common to all WNODE_*XXX*

structures, such as the buffer size, the GUID that represents a data block associated with a request, and flags that provide information about the WNODE_*XXX* data being passed or returned.

DataBlockOffset
Indicates the offset in bytes from the beginning of the WNODE_ALL_DATA structure to the beginning of data for the first instance

InstanceCount
Indicates the number of instances whose data follows the fixed members of the WNODE_ALL_DATA in the buffer at **IrpStack->Parameters.WMI.Buffer**.

OffsetInstanceNameOffsets
Indicates the offset in bytes from the beginning of the WNODE_ALL_DATA to an array of offsets to dynamic instance names Each instance name must be aligned on a USHORT boundary. If all instances to be returned have static instance names, WMI ignores **OffsetInstanceNameOffsets**

FixedInstanceSize
Indicates the size of each instance to be returned if all such instances are the same size This member is valid only if the driver sets WNODE_FLAG_FIXED_INSTANCE_SIZE in **WnodeHeader.Flags**

OffsetInstanceDataAndLength
If instances to be returned vary in size, **OffsetInstanceDataAndLength** is an array of **InstanceCount** OFFSETINSTANCEDATAANDLENGTH structures that specify the offset in bytes from the beginning of the WNODE_ALL_DATA to the beginning of each instance and its length OFFSETINSTANCEDATAANDLENGTH is defined as follows

```
typedef struct {
    ULONG OffsetInstanceData,
    ULONG LengthInstanceData,
} OFFSETINSTANCEDATAANDLENGTH, *POFFSETINSTANCEDATAANDLENGTH
```

OffsetInstanceData
Indicates the offset in bytes from the beginning of the WNODE_ALL_DATA to the instance data

LengthInstanceData
Indicates the length in bytes of the instance data

Each instance must be aligned on a USHORT boundary The **OffsetInstanceDataAndLength** member is valid only if the driver clears WNODE_FLAG_FIXED_INSTANCE_SIZE in **WnodeHeader.Flags**

Comments

A driver fills in a WNODE_ALL_DATA structure in response to an IRP_MN_QUERY_ALL_DATA request A driver might also generate a WNODE_ALL_DATA as an event

After filling in the fixed members of the structure, a driver writes instance data and dynamic instance names (if any) at **DataBlockOffset** and **OffsetInstanceNameOffsets** respectively in the buffer at **IrpStack->Parameters.WMI.Buffer** If WNODE_FLAG_FIXED_INSTANCE_SIZE is clear, the first offset follows the last element of the **OffsetInstanceDataAndLength** array plus padding so the data begins on an 8-byte boundary

Instance names must be USHORT aligned Instance data must be QUADWORD aligned

See Also

IRP_MN_QUERY_ALL_DATA, WNODE_EVENT_ITEM WNODE_HEADER

Built on Tuesday June 15 1999

Kernel-Mode Drivers Preliminary Windows 2000 DDK

WNODE_EVENT_ITEM

[This is preliminary documentation and subject to change]

```
typedef struct tagWNODE_EVENT_ITEM {
    struct _WNODE_HEADER WnodeHeader,
    // Rest of WNODE data indicated by flags in WnodeHeader
} WNODE_EVENT_ITEM, *PWNODE_EVENT_ITEM,
```

A WNODE_EVENT_ITEM contains data generated by a driver for an event

WnodeHeader
Is a WNODE_HEADER structure that contains information common to all WNODE_*XXX* structures such as the buffer size the GUID that represents a data block associated with a request and flags that provide information about the WNODE_*XXX* data being passed or returned

Comments

A WNODE_EVENT_ITEM contains whatever data the driver determines is appropriate for an event, in a WNODE_*XXX* structure that is appropriate for that data

A driver generates only events that it has previously enabled in response to an IRP_MN_ENABLE_EVENTS request To generate an event, a driver calls **IoWMIWriteEvent** and passes a pointer to the WNODE_EVENT_ITEM WMI queues the event for delivery to all data consumers registered for that event

For best performance, events should be small in size However, if the amount of data for an event exceeds the maximum size defined in the registry, a driver can pass a WNODE_EVENT_REFERENCE, which WMI uses to query for the related WNODE_EVENT_ITEM For more information about defining and generating WMI events, see the *Kernel mode Drivers Design Guide*

See Also

IoWMIWriteEvent, IRP_MN_ENABLE_EVENTS, WNODE_ALL_DATA, WNODE_EVENT_REFERENCE, WNODE_HEADER, WNODE_SINGLE_INSTANCE WNODE_SINGLE_ITEM

Built on Tuesday June 15 1999

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WNODE_EVENT_REFERENCE

[This is preliminary documentation and subject to change]

```
typedef struct tagWNODE_EVENT_REFERENCE {
    struct _WNODE_HEADER WnodeHeader,
    GUID TargetGuid,
    ULONG TargetDataBlockSize,
    union
    {
        ULONG TargetInstanceIndex
        WCHAR TargetInstanceName[],
    },
} WNODE_EVENT_REFERENCE, *PWNODE_EVENT_REFERENCE,
```

A WNODE_EVENT_REFERENCE contains information that WMI can use to query for an event that exceeds the event size limit set in the registry

Members

WnodeHeader
Is a WNODE_HEADER structure that contains information common to all WNODE_*XXX* structures, such as the buffer size the GUID that represents a data block associated with a request, and flags that provide information about the WNODE_*XXX* data being passed or returned

TargetGuid
Indicates the GUID that represents the event to query

TargetDataBlockSize
Indicates the size of the event

TargetInstanceIndex
Indicates the index into the driver's list of static instance names for the event This member is valid only if the event block was registered with static instance names and WNODE_FLAGS_STATIC_INSTANCE_NAMES is set in **WnodeHeader.Flags**

TargetInstanceName
Indicates the dynamic instance name of the event as a counted Unicode string This member is valid only if WNODE_FLAGS_STATIC_INSTANCE_NAMES is clear in **WnodeHeader.Flags** and the event block was registered with dynamic instance names

Comments

If the amount of data for an event exceeds the maximum size set in the registry, a driver can generate a WNODE_EVENT_REFERENCE that specifies a WNODE_EVENT_ITEM that WMI can query to obtain the event For more information about defining and generating WMI events, see the *Kernel-mode Drivers Design*

See Also

WNODE_EVENT_ITEM, WNODE_HEADER

Built on Tuesday, June 15, 1999

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WNODE_HEADER

[This is preliminary documentation and subject to change.]

```
typedef struct _WNODE_HEADER {
    ULONG BufferSize;
    UINT_PTR ProviderId;
    union {
        ULONG64 HistoricalContext;
        struct {
            ULONG Version;
            ULONG Linkage;
        };
    };
    union {
        HANDLE KernelHandle;
        LARGE_INTEGER TimeStamp;
    };
    GUID Guid;
    ULONG ClientContext;
    ULONG Flags;
} WNODE_HEADER, *PWNODE_HEADER;
```

A WNODE_HEADER is the first member of all other WNODE_*XXX* structures. It contains information common to all such structures.

Members

BufferSize
: Specifies the size in bytes of the nonpaged buffer to receive any WNODE_*XXX* data to be returned, including this WNODE_HEADER, additional members of a WNODE_*XXX* structure of the type indicated by **Flags** and any WMI- or driver-determined data that accompanies that structure.

ProviderId
: Reserved for WMI.

HistoricalContext
: Reserved for WMI.

Version
: Reserved for WMI.

Linkage
: Reserved for WMI.

TimeStamp
: Indicates the system time a driver collected the WNODE_*XXX* data, in units of 100

nanoseconds since 1/1/1601. A driver can call **KeQuerySystemTime** to obtain this value. If the block is to be written to a log file (WNODE_FLAG_LOG_WNODE), an NT driver might also set WNODE_FLAG_USE_TIMESTAMP in **Flags** to request the system logger to leave the value of **TimeStamp** unchanged.

KernelHandle
: Reserved for WMI.

Guid
: Indicates the GUID that represents the data block associated with the WNODE_*XXX* to be returned.

ClientContext
: Reserved for WMI.

Flags
: Indicates the type of WNODE_*XXX* structure that contains the WNODE_HEADER.

WNODE_FLAG_ALL_DATA
: The rest of a WNODE_ALL_DATA structure follows the WNODE_HEADER in the buffer.

  WMI sets this flag in the WNODE_HEADER it passes with an IRP_MN_QUERY_ALL_DATA request.

  A driver sets this flag in the WNODE_HEADER of an event that consists of all instances of a data block. If the data block size is identical for all instances, a driver also sets WNODE_FLAG_FIXED_INSTANCE_SIZE.

WNODE_FLAG_EVENT_ITEM
: A driver sets this flag to indicate that the WNODE_XXX structure was generated as an event. This flag is valid only if WNODE_FLAG_ALL_DATA, WNODE_FLAG_SINGLE_INSTANCE, or WNODE_FLAG_SINGLE_ITEM is also set.

WNODE_FLAG_EVENT_REFERENCE
: The rest of a WNODE_EVENT_REFERENCE structure follows the WNODE_HEADER in the buffer.

  A driver sets this flag when it generates an event that is larger than the maximum size specified in the registry for an event. WMI uses the information in the WNODE_EVENT_REFERENCE to request the event data and schedules such a request according to the value of WNODE_FLAG_SEVERITY_MASK.

WNODE_FLAG_METHOD_ITEM
: The rest of a WNODE_METHOD_ITEM structure follows the WNODE_HEADER in the buffer.

  WMI sets this flag in the WNODE_HEADER it passes with an IRP_MN_EXECUTE_METHOD request.

WNODE_FLAG_SINGLE_INSTANCE
: The rest of a WNODE_SINGLE_INSTANCE structure follows the WNODE_HEADER in the buffer.

  WMI sets this flag in the WNODE_HEADER it passes with a request to query or change an instance.

A driver sets this flag in the WNODE_HEADER of an event that consists of a single instance of a data block

WNODE_FLAG_SINGLE_ITEM

The rest of a WNODE_SINGLE_ITEM structure follows the WNODE_HEADER in the buffer

WMI sets this flag in the WNODE_HEADER it passes with a request to change an item

A driver sets this flag in the WNODE_HEADER of an event that consists of a single data item

WNODE_FLAG_TOO_SMALL

The rest of a WNODE_TOO_SMALL structure follows the WNODE_HEADER in the buffer

A driver sets this flag when it passes a WNODE_TOO_SMALL indicating that the buffer is too small for all of the WNODE_*XXX* data to be returned

In addition, **Flags** might be set with one or more of the following flags that provide additional information about the WNODE_*XXX*

WNODE_FLAG_FIXED_INSTANCE_SIZE

All instances of a data block are the same size. This flag is valid only if WNODE_FLAG_ALL_DATA is also set

WNODE_FLAG_INSTANCES_SAME

The number of instances and the dynamic instance names in a WNODE_ALL_DATA to be returned are identical to those returned from the previous WNODE_ALL_DATA query. This flag is valid only if WNODE_FLAG_ALL_DATA is also set. This flag is ignored for data blocks registered with static instance names

For optimized performance, a driver should set this flag if it can track changes to the number or names of its data blocks. WMI can then skip the processing required to detect and update dynamic instance names

WNODE_FLAG_STATIC_INSTANCE_NAMES

The WNODE_*XXX* data to be returned does not include instance names

WMI sets this flag before requesting WNODE_*XXX* data for data blocks registered with static instance names. After receiving the returned WNODE_*XXX* from the driver, WMI fills in the static instance names specified at registration before passing the returned WNODE_*XXX* to a data consumer

WNODE_FLAG_PDO_INSTANCE_NAMES

Static instance names are based on the device instance ID of the PDO for the device. A driver requests such names by setting WMIREG_FLAG_INSTANCE_PDO in the WMIREGGUID it uses to register the block

WMI sets this flag before requesting WNODE_*XXX* data for data blocks registered with PDO-based instance names

WNODE_FLAG_SEVERITY_MASK

The driver-determined severity level of the event associated with a returned WNODE_EVENT_REFERENCE, with 0x00 indicating the least severe and 0xff

indicating the most severe level

WMI uses the value of this flag to prioritize its requests for the event data

WNODE_FLAG_USE_TIMESTAMP

The system logger should not modify the value of **TimeStamp** set by the driver

An NT driver might also set **Flags** to one or more of the following values for event blocks to be written to a system log file

WNODE_FLAG_LOG_WNODE

An event block is to be sent to the system logger. The event header is a standard WNODE_HEADER structure. If the driver clears WNODE_FLAG_TRACED_GUID the block will also be sent to WMI for delivery to any data consumers that have enabled the event. The driver must allocate the WNODE_*XXX* from pool memory. WMI frees the memory after delivering the event to data consumers

WNODE_FLAG_TRACED_GUID

An event block is to be sent only to the system logger. It does not get sent to WMI data consumers. The event header is an EVENT_TRACE_HEADER structure, declared in *evntrace h*, instead of a WNODE_HEADER. The driver must allocate memory for the WNODE_*XXX* and free it after **IoWMIWriteEvent** returns. The driver can allocate such memory either from the stack or, to minimize the overhead of allocating and freeing the memory, from the driver's thread local storage if the driver creates and maintains its own thread pool

WNODE_FLAG_USE_GUID_PTR

The **Guid** member points to a GUID in memory, rather than containing the GUID itself. The system logger dereferences the pointer before passing the data to the consumer. This flag is valid only if WNODE_FLAG_LOG_WNODE or WNODE_FLAG_TRACED_GUID are also set

WNODE_FLAG_USE_MOF_PTR

Data that follows the fixed members of a WNODE_*XXX* structure consists of an array of MOF_FIELD structures, defined in *evntrace h*, that contain pointers to data and sizes rather than the data itself. The array can contain up to MAX_MOF_FIELD elements. The system logger dereferences the pointers before passing the data to the consumer. This flag is valid only for blocks registered with WMIREG_FLAG_TRACED_GUID

Comments

In an IRP_MN_CHANGE_*XXX* or IRP_MN_EXECUTE_METHOD request, **BufferSize** in the IRP indicates the maximum size in bytes of the output buffer, while **BufferSize** in the input WNODE_HEADER for such a request indicates the size in bytes of the input data in the buffer

See Also

IoWMIWriteEvent, **KeQuerySystemTime**, WNODE_ALL_DATA, WNODE_EVENT_ITEM, WNODE_EVENT_REFERENCE, WNODE_METHOD_ITEM, WNODE_SINGLE_INSTANCE, WNODE_SINGLE_ITEM, WNODE_TOO_SMALL

Built on Tuesday, June 15 1999

Kernel-Mode Drivers Preliminary Windows 2000 DDK

WNODE_METHOD_ITEM

[This is preliminary documentation and subject to change]

```
typedef struct tagWNODE_METHOD_ITEM {
    struct _WNODE_HEADER WnodeHeader,
    ULONG OffsetInstanceName,
    ULONG InstanceIndex,
    ULONG MethodId,
    ULONG DataBlockOffset,
    ULONG SizeDataBlock,
    UCHAR VariableData[],
} WNODE_METHOD_ITEM, *PWNODE_METHOD_ITEM,
```

A WNODE_METHOD_ITEM indicates a method associated with an instance of a data block and contains any input data for the method

Members

WnodeHeader
: Is a WNODE_HEADER structure that contains information common to all WNODE_*XXX* structures, such as the buffer size, the GUID that represents a data block associated with a request, and flags that provide information about the WNODE_*XXX* data being passed or returned

OffsetInstanceName
: Indicates the offset in bytes from the beginning of this structure to the dynamic instance name of this instance, aligned on a USHORT boundary This member is valid only if WNODE_FLAG_STATIC_INSTANCE_NAMES is clear in **WnodeHeader.Flags** If the data block was registered with static instance names, WMI ignores **OffsetInstanceName**

InstanceIndex
: Indicates the index of this instance into the driver's list of static instance names for this data block This member is valid only if the data block was registered with static instance names and WNODE_FLAG_STATIC_INSTANCE_NAME is set in **WnodeHeader.Flags** If the data block was registered with dynamic instance names, WMI ignores **InstanceIndex**

MethodId
: Specifies the ID of the method to execute

DataBlockOffset
: Indicates the offset from the beginning of an input WNODE_METHOD_ITEM to input data for the method, or the offset from the beginning of an output WNODE_METHOD_ITEM to output data from the method

SizeDataBlock
: Indicates the size of the input data in an input WNODE_METHOD_ITEM or zero if there is no input In an output WNODE_METHOD_ITEM **SizeDataBlock** indicates the size of the output data, or zero if there is no output

VariableData
: Contains additional data including the dynamic instance name if any and the input for or output from the method aligned on an 8-byte boundary

Comments

WMI passes a WNODE_METHOD_ITEM with an IRP_MN_EXECUTE_METHOD request to specify a method to execute in an instance of a data block, plus any input data required by the method

If a method generates output, a driver overwrites the input data with the output at **DataBlockOffset** in the buffer at **IrpStack->Parameters.WMI.Buffer**, and sets **SizeDataBlock** in the WNODE_METHOD_ITEM to specify the size of the output data

See Also

WNODE_HEADER

Built on Tuesday, June 15, 1999

Kernel-Mode Drivers Preliminary Windows 2000 DDK

WNODE_SINGLE_INSTANCE

[This is preliminary documentation and subject to change]

```
typedef struct tagWNODE_SINGLE_INSTANCE {
    struct _WNODE_HEADER WnodeHeader,
    ULONG OffsetInstanceName,
    ULONG InstanceIndex,
    ULONG DataBlockOffset,
    ULONG SizeDataBlock,
    UCHAR VariableData[],
} WNODE_SINGLE_INSTANCE  *PWNODE_SINGLE_INSTANCE,
```

A WNODE_SINGLE_INSTANCE contains values for all data items in one instance of a data block

Members

WnodeHeader
: Is a WNODE_HEADER structure that contains information common to all WNODE_*XXX* structures, such as the buffer size, the GUID that represents a data block associated with a request, and flags that provide information about the WNODE_*XXX* data being passed or returned

OffsetInstanceName
: Indicates the offset from the beginning of this structure to the dynamic instance name of this instance aligned on a USHORT boundary This member is valid only if WNODE_FLAG_STATIC_INSTANCE_NAMES is clear in **WnodeHeader.Flags** If the data block was registered with static instance names, WMI ignores **OffsetInstanceName**

InstanceIndex
: Indicates the index of an instance registered with static instance names This member is valid only if WNODE_FLAG_STATIC_INSTANCE_NAME is set in **WnodeHeader.Flags** If the data block was registered with dynamic instance names WMI ignores **InstanceIndex**

DataBlockOffset

Indicates the offset from the beginning of this structure to the beginning of the instance

SizeDataBlock
Indicates the size of the data block for this instance

VariableData
Contains additional data, including the dynamic instance name if any padding so the instance begins on an 8-byte boundary, and the instance of the data block to be returned

Comments

WMI passes a WNODE_SINGLE_INSTANCE with an IRP_MN_CHANGE_SINGLE_INSTANCE request to set read-write data items in an instance of a data block A driver can ignore values passed for read-only data items in the instance

A driver fills in a WNODE_SINGLE_INSTANCE in response to an IRP_MN_QUERY_SINGLE_INSTANCE request or to generate an event that consists of a single instance

See Also

WNODE_EVENT_ITEM, WNODE_HEADER

Built on Tuesday, June 15, 1999

Kernel-Mode Drivers Preliminary Windows 2000 DDK

WNODE_SINGLE_ITEM

[This is preliminary documentation and subject to change]

```
typedef struct tagWNODE_SINGLE_ITEM {
    struct _WNODE_HEADER WnodeHeader;
    ULONG OffsetInstanceName,
    ULONG InstanceIndex,
    ULONG ItemId,
    ULONG DataBlockOffset,
    ULONG SizeDataItem,
    UCHAR VariableData[],
} WNODE_SINGLE_ITEM, *PWNODE_SINGLE_ITEM;
```

A WNODE_SINGLE_ITEM contains the value of a single data item in an instance of a data block

Members

WnodeHeader
Is a WNODE_HEADER structure that contains information common to all WNODE_*XXX* structures, such as the buffer size, the GUID that represents a data block associated with a request, and flags that provide information about the WNODE_*XXX* data being passed or returned

OffsetInstanceName
Indicates the offset from the beginning of this structure to the dynamic instance name, if any,

aligned on a USHORT boundary This member is valid only if WNODE_FLAG_STATIC_INSTANCE_NAMES is clear in **WnodeHeader.Flags** If the data block was registered with static instance names WMI ignores **OffsetInstanceName**

InstanceIndex
Indicates the index into the driver's list of static instance names of this instance This member is valid only if the data block was registered with static instance names and WNODE_FLAG_STATIC_INSTANCE_NAME is set in **WnodeHeader.Flags** If the data block was registered with dynamic instance names, WMI ignores **InstanceIndex**

ItemId
Specifies the ID of the data item to set

DataBlockOffset
Indicates the offset from the beginning of this structure to the new value for the data item

SizeDataItem
Indicates the size of the data item

VariableData
Contains additional data including the dynamic instance name if any, padding so the data value begins on an 8-byte boundary, and the new value for the data item

Comments

WMI passes a WNODE_SINGLE_ITEM with an IRP_MN_CHANGE_SINGLE_ITEM request to set the value of a data item in an instance of a data block

A driver builds a WNODE_SINGLE_ITEM to generate an event that consists of a single data item

See Also

WNODE_EVENT_ITEM, WNODE_HEADER

Built on Tuesday, June 15, 1999

Kernel-Mode Drivers Preliminary Windows 2000 DDK

WNODE_TOO_SMALL

[This is preliminary documentation and subject to change]

```
typedef struct tagWNODE_TOO_SMALL {
    struct _WNODE_HEADER WnodeHeader,
    ULONG SizeNeeded,
} WNODE_TOO_SMALL, *PWNODE_TOO_SMALL,
```

A WNODE_TOO_SMALL indicates the size of the buffer needed to receive output from a request

Members

WnodeHeader
Is a WNODE_HEADER structure that contains information common to all WNODE_*XXX* structures, such as the buffer size, the GUID that represents a data block associated with a

request, and flags that provide information about the WNODE_*XXX* data being passed or returned.

SizeNeeded

Specifies the size of the buffer needed to receive all of the WNODE_*XXX* data to be returned

Comments

When the buffer for a WMI request is too small to receive all of the data to be returned, a driver fills in a WNODE_TOO_SMALL structure to indicate the required buffer size WMI can then increase the buffer to the recommended size and issue the request again A driver is responsible for managing any side effects caused by handling the same request more than once

See Also

WNODE_HEADER

Built on Tuesday, June 15, 1999

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Chapter 5 WMI Event Trace Structures

[This is preliminary documentation and subject to change]

This section describes the structure that is used to send WMI events to the WMI event logger

Built on Tuesday, June 15, 1999

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EVENT_TRACE_HEADER

[This is preliminary documentation and subject to change]

```
typedef struct _EVENT_TRACE_HEADER {
    USHORT Size,
    UCHAR HeaderType,
    UCHAR MarkerFlags,
    union {
        ULONG Version,
        struct {
            UCHAR Type,
            UCHAR Level,
            USHORT Version,
        } Class,
    },
    ULONGLONG ThreadId,
    LARGE_INTEGER TimeStamp,
    union {
        GUID Guid,
```



```
        ULONGULONG GuidPtr,
    },
    union {
        struct {
            ULONG ClientContext,
            ULONG Flags,
        },
        struct {
            ULONG KernelTime,
            ULONG UserTime,
        };
    ULONG64 ProcessorTime,
} EVENT_TRACE_HEADER, *PEVENT_TRACE_HEADER,
```

An EVENT_TRACE_HEADER structure is used to pass a WMI event to the WMI event logger. It is overlaid on the WNODE_HEADER portion of the WNODE_EVENT_ITEM passed to **IoWMIFireEvent**. Information contained in the EVENT_TRACE_HEADER is written to the WMI log file

Members

Size

Specifies the size in bytes of this structure This value should be set to - SIZEOF (EVENT_TRACE_HEADER) plus the size of any driver data appended to the end of this structure (Note The sizeof this member is smaller than the sizeof the **Size** member of the WNODE_HEADER structure on which this structure is overlaid)

HeaderType

Reserved for internal use

MarkerFlags

Reserved for internal use

Version

Drivers can use this member to store version information This information is not interpreted by the event logger

Class

Type

Trace event type This can be one of the predefined EVENT_TRACE_TYPE_Xxx values contained in evntrace h or can be a driver defined value Callers are free to define private event types with values greater than the reserved values in evntrace h

Level

Trace instrumentation level A driver defined value meant to represent the degree of detail of the trace instrumentation Drivers are free to give this value meaning This value should be 0 by default More information on how consumers can request different levels of trace information will be provided in a future version of the documentation **Version**

Version of trace record Version information that can be used by the driver to track different event formats

ThreadId

Reserved for internal use

TimeStamp

Indicates the time the driver event occurred. This time is indicated in units of 100 nanoseconds since 1/1/1601 If the WNODE_FLAG_USE_TIMESTAMP is set in **Flags**, the system logger will leave the value of TimeStamp unchanged Otherwise, the system logger will set the value

of **TimeStamp** at the time it receives the event. A driver can call **KeQuerySystemTime** to set the value of **TimeStamp**

Guid
: Indicates the GUID that identifies the data block for the event

GuidPtr
: If the WNODE_FLAG_USE_GUID_PTR is set in **Flags**, **GuidPtr** points to the GUID that identifies the data block for the event

ClientContext
: Reserved for internal use.

Flags
: Provides information about the contents of this structure. For information on EVENT_TRACE_HEADER **Flags** values, see the **Flags** description in WNODE_HEADER

KernelTime
: Reserved for internal use

UserTime
: Reserved

ProcessorTime
: Reserved for internal use

Comments

A driver which supports trace events will use this structure to report events to the WMI event logger. Trace events should not be reported until the driver receives a request to enable events and the control GUID is one the driver supports. The driver should initialize an EVENT_TRACE_HEADER structure, fill in any user defined event data at the end and pass a pointer to the EVENT_TRACE_HEADER to **IoWmiWriteEvent**. The driver should continue reporting trace events until it receives a request to disable the control GUID for the trace events.

See Also

WNODE_HEADER, WNODE_EVENT_ITEM, **IoWMIWriteEvent**

Built on Tuesday, June 15, 1999

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A computer-readable medium having computer executable components, comprising:

a device driver configured to provide information and perform actions associated with a hardware device; and

a driver library containing software routines to make the information and actions provided by the device driver accessible to a management system, the library being accessible by the device driver to handle messages issued to the device driver from the management system.

2. The computer-readable medium of Claim 1, wherein the device driver is further configured with a unique software routine particular to the device driver and related to the hardware device.

3. The computer-readable medium of Claim 2, wherein the device driver is further configured to execute the unique software routine in response to a call from the driver library.

4. The computer-readable medium of Claim 3, wherein the driver library is further configured to call the unique software routine and cause the unique software routine to execute.

5. The computer-readable medium of Claim 3, wherein the unique software routine is configured to retrieve data and perform actions associated with the hardware device.

6. The computer-readable medium of Claim 3, wherein the unique software routine is configured to set a block of data stored on the hardware device.

7. The computer-readable medium of Claim 3, wherein the unique software routine is configured to execute a method associated with the information associated with the hardware device, the method being operative to pass additional information between the device driver and the management system or perform a certain action.

8. The computer-readable medium of Claim 7, wherein the driver library contains a software routine to format the additional information in a format consistent with the management system.

9. The computer-readable medium of Claim 1, wherein the driver library is a dynamically accessible software library.

10. The computer-readable medium of Claim 9, wherein the driver library is further configured to receive, from the device driver, an identifier for a particular Input/Output Request Packet ("IRP"), and to execute a particular software routine related to handling the IRP.

11. The computer-readable medium of Claim 1, wherein the driver library is further configured to receive, from the device driver, an identifier for a particular IRP, to execute a particular software routine related to handling the IRP, and to return to the management system any information retrieved from the hardware device as a result of handling the IRP.

12. The computer-readable medium of Claim 1, wherein the driver library is a static library associated with the device driver.

13. A computer-readable medium having computer-executable instructions for providing management information to a management system, which, when executed, comprise:

receiving an input/output request packet ("IRP") message from the management system, the IRP message including instructions regarding data maintained by an instrumented hardware device;

passing the IRP to a driver library containing software routines for handling the instructions of the IRP message; and

handling the IRP message by the driver library.

14. The computer-readable medium of Claim 13, wherein passing the IRP to the driver library comprises determining whether the IRP is intended for a particular device driver.

15. The computer-readable medium of Claim 14, further comprising if the IRP is not intended for the particular device driver, passing the IRP to a next device driver in a driver stack.

16. The computer-readable medium of Claim 13, wherein handling the IRP message by the driver library comprises calling back to a device driver associated with the instrumented hardware device to request data from or perform an action by the device driver.

17. The computer-readable medium of Claim 13, wherein handling the IRP message by the driver library comprises calling back to a device driver associated with the instrumented hardware device to request that data be set at the instrumented hardware device.

18. The computer-readable medium of Claim 13, wherein handling the IRP message by the driver library comprises calling back to a device driver associated with the instrumented hardware device to cause a unique software routine within the device driver to be executed, the unique software routine being configured to perform a function related to the instrumented hardware device.

19. The computer-readable medium of Claim 18, wherein the driver library is further configured to format data received from the device driver in a format consistent with the management system.

SYSTEM, METHOD AND APPARATUS FOR SUPPORTING A KERNEL MODE DRIVER

Abstract of the Disclosure

An invention is disclosed that provides a set of common software routines that may be accessed by device drivers in support of the Windows Management Instrumentation system. The set of common routines includes typical routines that would ordinarily be executed by device drivers designed in accordance with WMI. The common routines may reside in a library, dynamically accessible by the device drivers. When a device driver receives a message from the WMI system, the device driver may pass the message to the library to be handled in a common manner. In this manner, the developers of device drivers in accordance with the WMI system need only develop so much code as is necessary to support any unique features or data storage of its associated hardware. The result is shortened development time and fewer programming errors. In addition, the overall system performance may be improved because fewer instances of similar code are loaded in memory to support the WMI system.

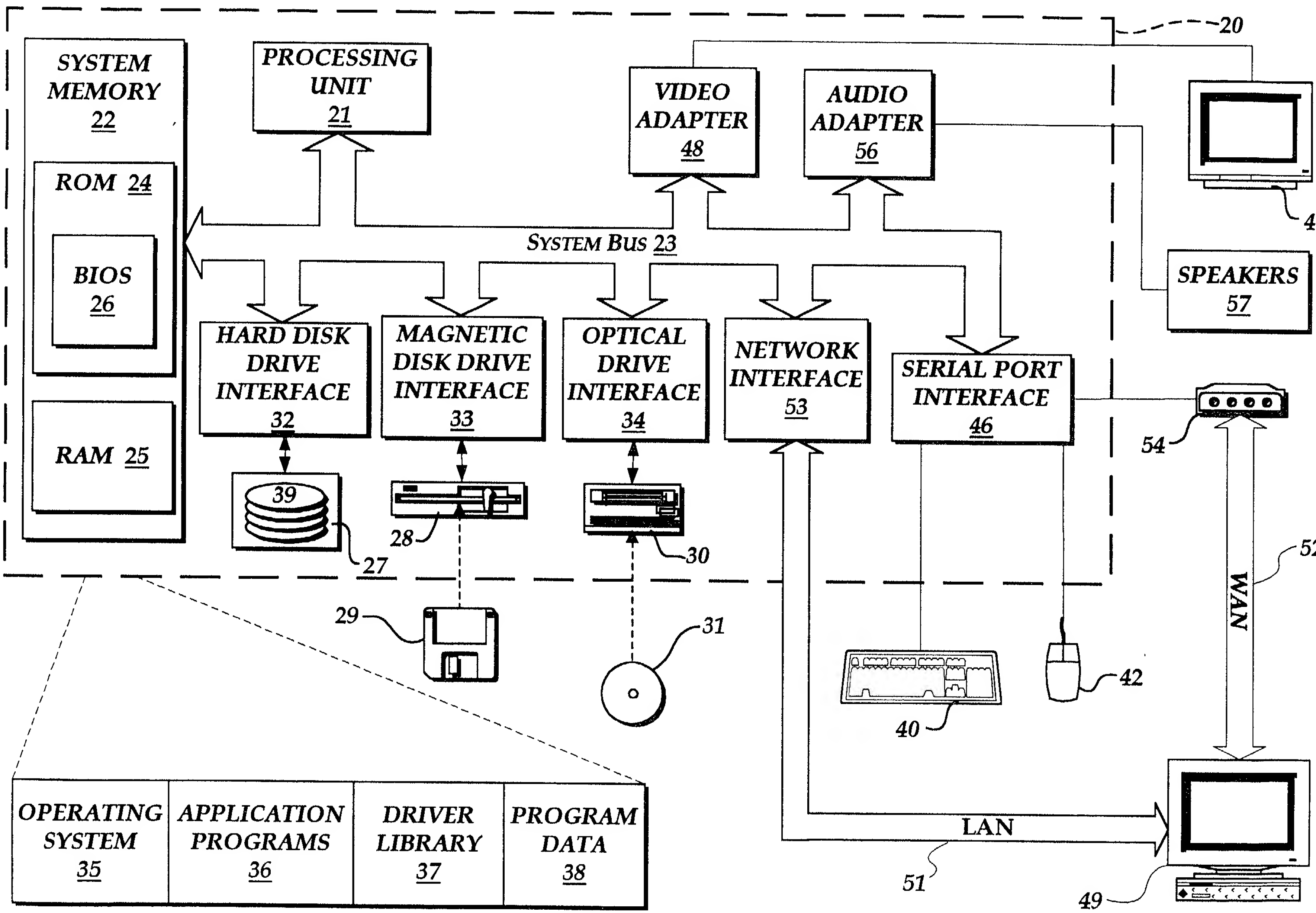
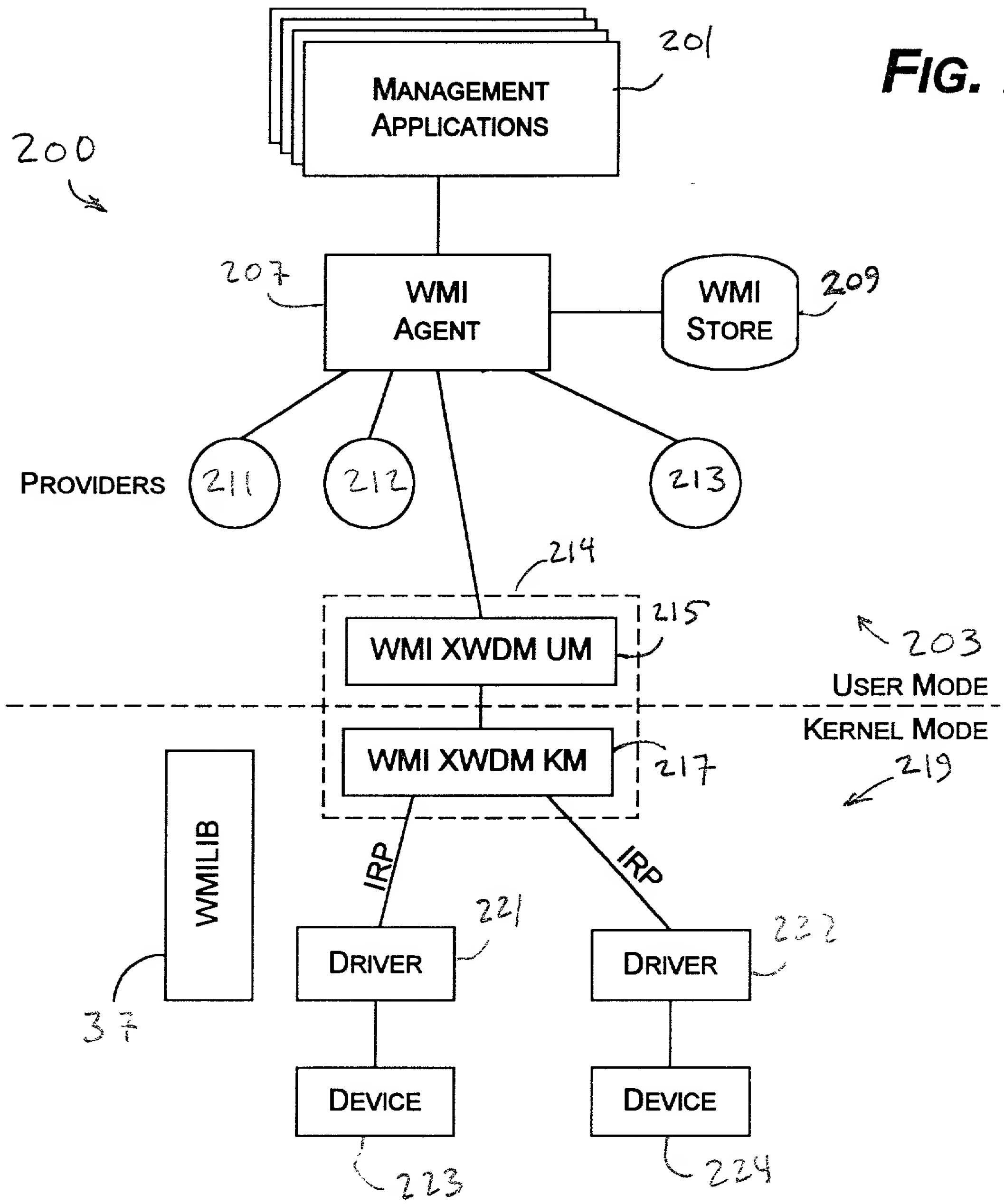

20
SYSTEM MEMORY 22
ROM 24
BIOS 26
RAM 25
PROCESSING UNIT 21
VIDEO ADAPTER 48
AUDIO ADAPTER 56
47
SPEAKERS 57
SYSTEM BUS 23
HARD DISK DRIVE INTERFACE 32
MAGNETIC DISK DRIVE INTERFACE 33
OPTICAL DRIVE INTERFACE 34
NETWORK INTERFACE 53
SERIAL PORT INTERFACE 46
39
27
28
29
30
31
54
52
WAN
40
42
LAN
51
49
OPERATING SYSTEM 35
APPLICATION PROGRAMS 36
DRIVER LIBRARY 37
PROGRAM DATA 38

FIG. 1

FIG. 2



MANAGEMENT APPLICATIONS
201
200
207
WMI AGENT
WMI STORE
209
PROVIDERS
211
212
213
214
215
WMI XWDM UM
203
USER MODE
KERNEL MODE
WMI XWDM KM
217
219
WMILIB
IRP
IRP
221
222
DRIVER
DRIVER
37
DEVICE
DEVICE
223
224

FIG. 3

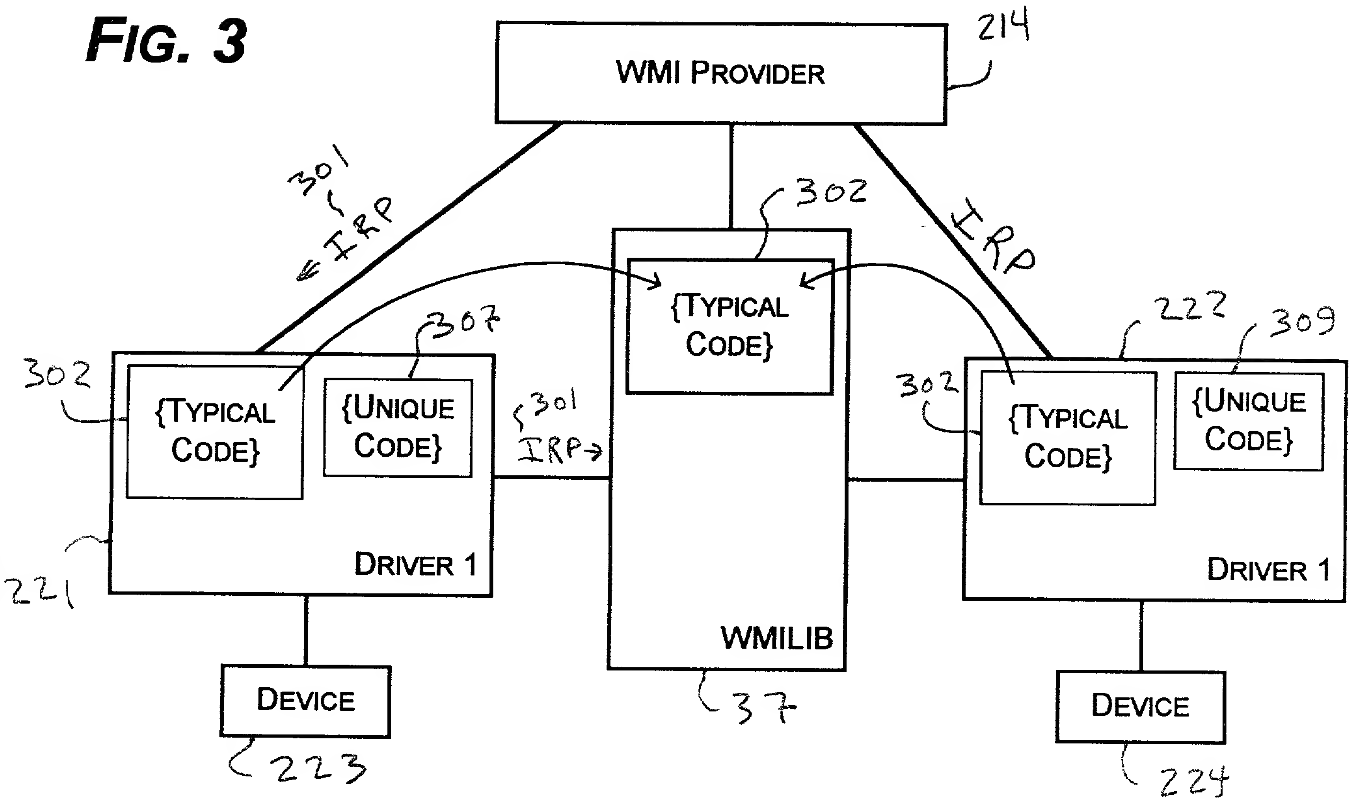
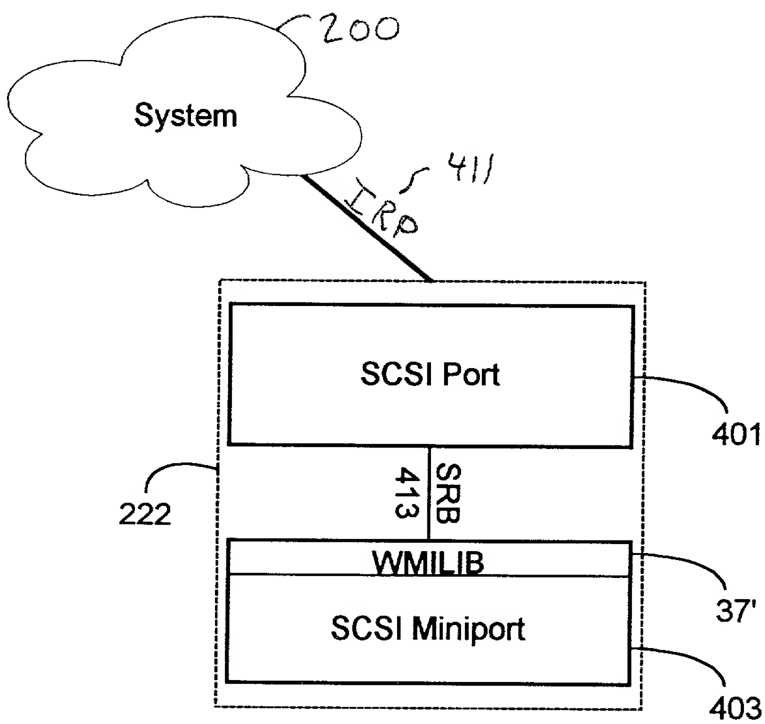

WMI PROVIDER
214
301
IRP
302
{TYPICAL CODE}
307
{UNIQUE CODE}
DRIVER 1
221
DEVICE
223
WMILIB
37
222
309
DEVICE
224

FIG. 4


System
200
411
IRP
SCSI Port
401
SRB
413
222
WMILIB
37'
SCSI Miniport
403

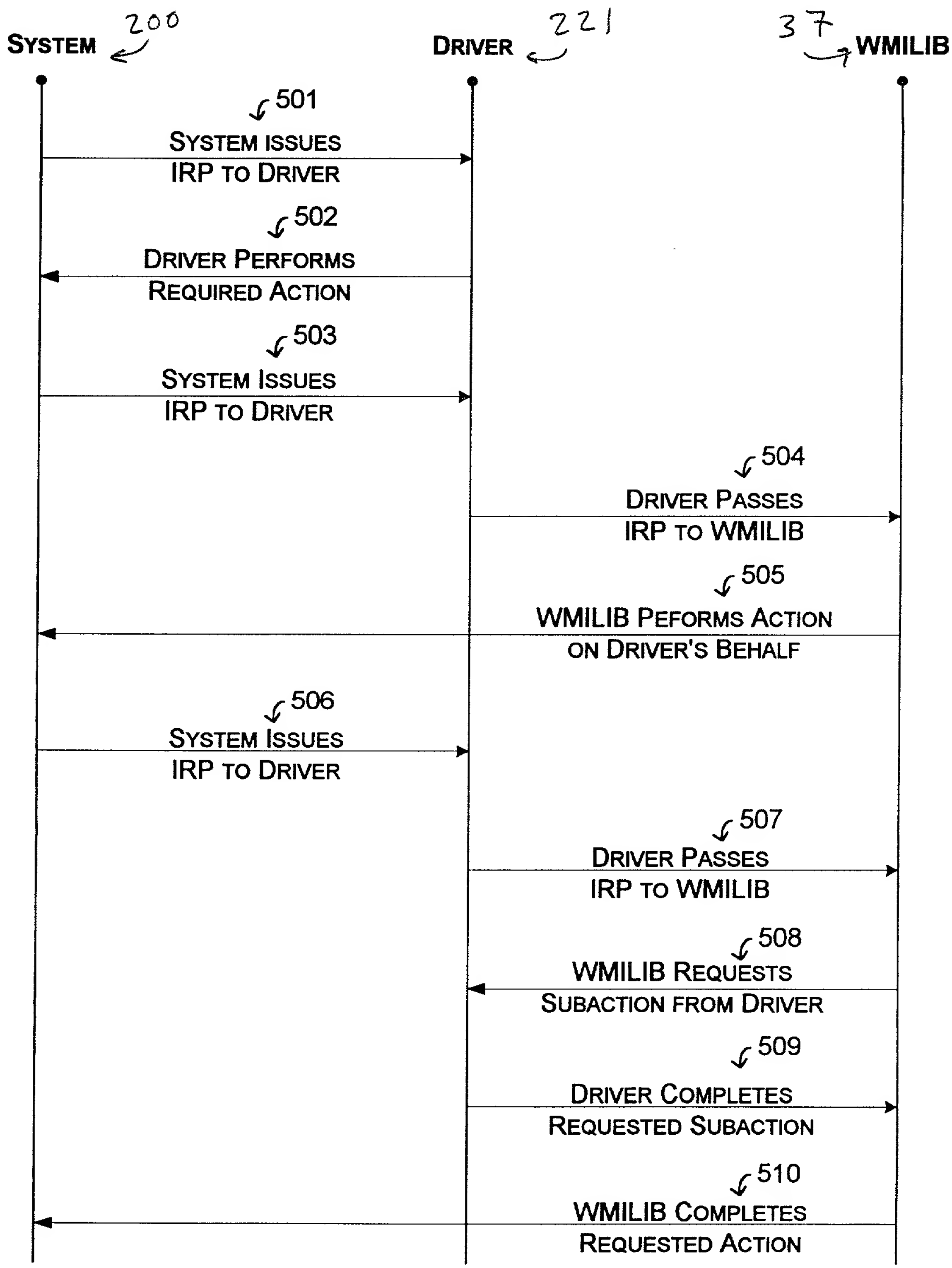

SYSTEM
200
DRIVER
221
37
WMILIB
501
SYSTEM ISSUES IRP TO DRIVER
502
DRIVER PERFORMS REQUIRED ACTION
503
SYSTEM ISSUES IRP TO DRIVER
504
DRIVER PASSES IRP TO WMILIB
505
WMILIB PEFORMS ACTION ON DRIVER'S BEHALF
506
SYSTEM ISSUES IRP TO DRIVER
507
DRIVER PASSES IRP TO WMILIB
508
WMILIB REQUESTS SUBACTION FROM DRIVER
509
DRIVER COMPLETES REQUESTED SUBACTION
510
WMILIB COMPLETES REQUESTED ACTION

FIG. 5

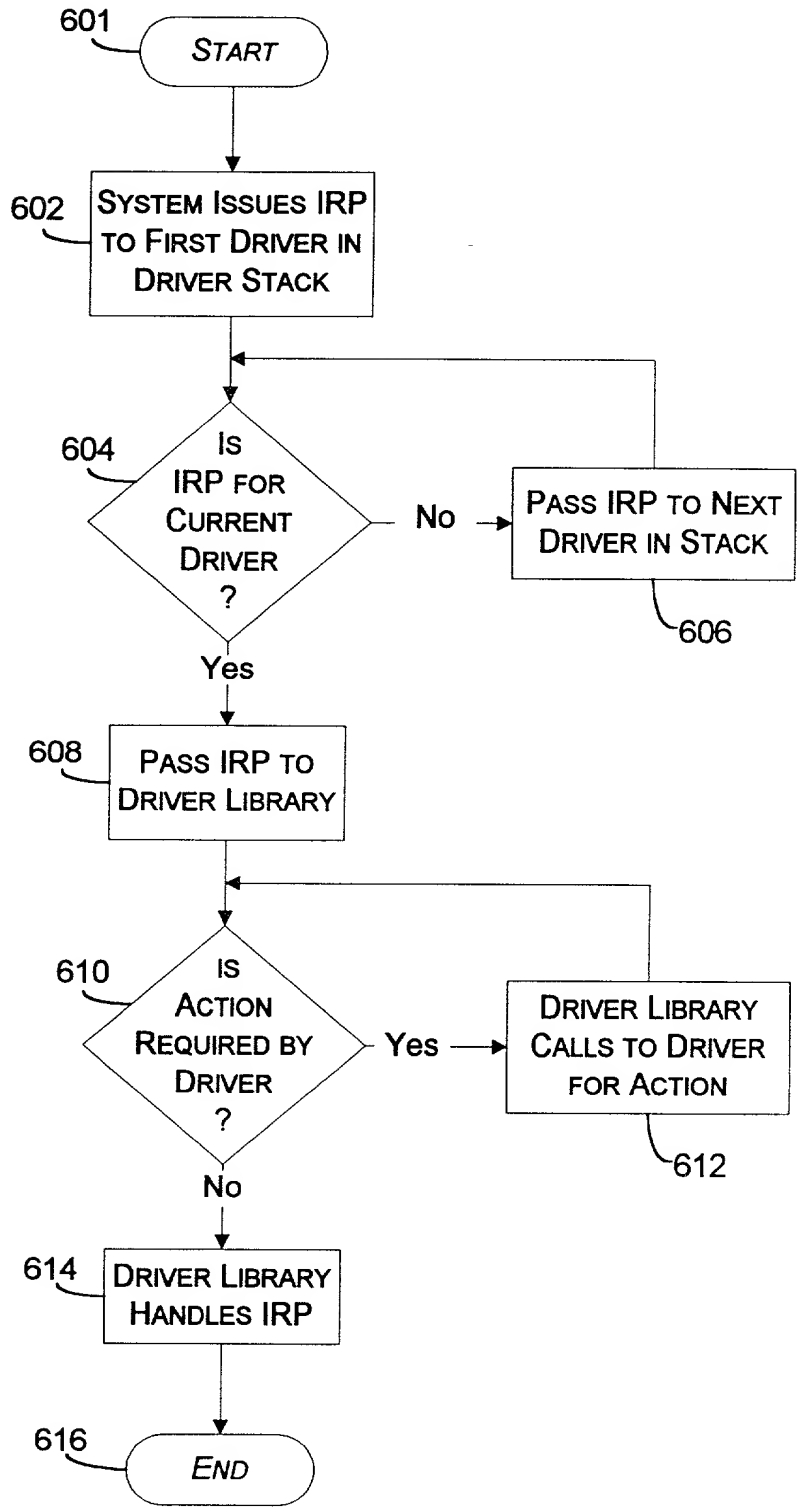

601
START
602
SYSTEM ISSUES IRP TO FIRST DRIVER IN DRIVER STACK
604
IS IRP FOR CURRENT DRIVER ?
No
PASS IRP TO NEXT DRIVER IN STACK
606
Yes
608
PASS IRP TO DRIVER LIBRARY
610
IS ACTION REQUIRED BY DRIVER ?
Yes
DRIVER LIBRARY CALLS TO DRIVER FOR ACTION
612
No
614
DRIVER LIBRARY HANDLES IRP
616
END

FIG. 6

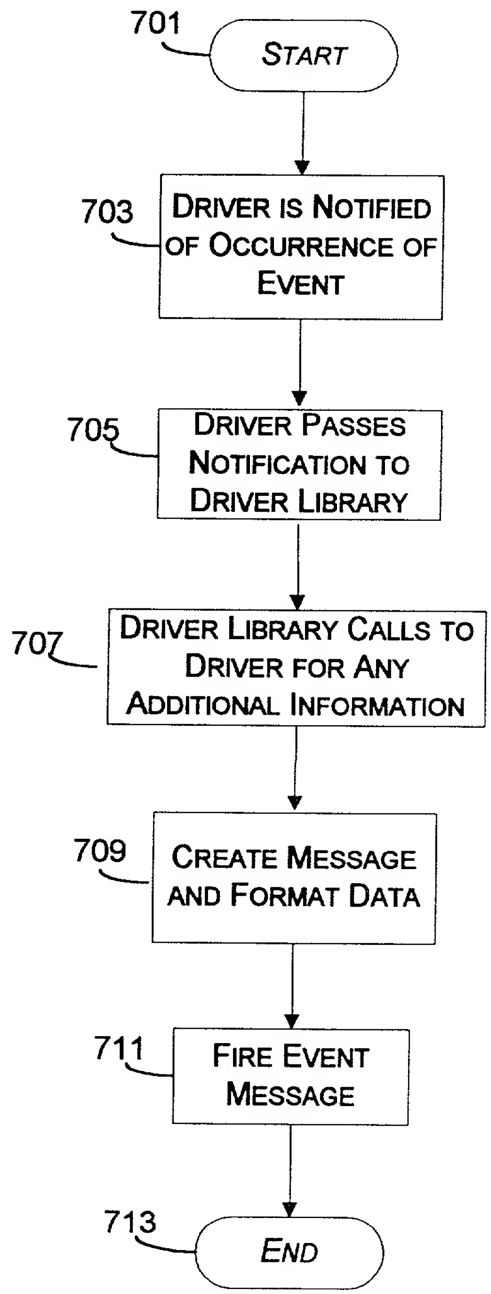

701
START
703
DRIVER IS NOTIFIED OF OCCURRENCE OF EVENT
705
DRIVER PASSES NOTIFICATION TO DRIVER LIBRARY
707
DRIVER LIBRARY CALLS TO DRIVER FOR ANY ADDITIONAL INFORMATION
709
CREATE MESSAGE AND FORMAT DATA
711
FIRE EVENT MESSAGE
713
END

FIG. 7